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REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT  
BARABOO, WISCONSIN

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**FINAL**  
**REMEDIAL INVESTIGATION REPORT**  
DATA ITEM A011

US ARMY ENVIRONMENTAL CENTER  
ABERDEEN PROVING GROUND MD 21010-5401

**VOLUME II OF II**  
**TABLES AND FIGURES**

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U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
ABERDEEN PROVING GROUND, MARYLAND

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REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT  
BARABOO, WISCONSIN

FINAL  
REMEDIAL INVESTIGATION REPORT  
DATA ITEM A011

CONTRACT DAAA15-91-D-0008  
TASK ORDER 1

*Prepared for:*

United States Army  
Toxic and Hazardous Materials Agency  
Aberdeen Proving Ground, Maryland

*Prepared by:*

ABB Environmental Services, Inc.  
Portland, Maine  
Project No. 6853-10

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# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS

Section	Title	Page No.
<b>EXECUTIVE SUMMARY . . . . . ES-1</b>		
<b>1.0</b>	<b>INTRODUCTION . . . . .</b>	<b>1-1</b>
1.1	PURPOSE . . . . .	1-2
1.2	SCOPE . . . . .	1-3
1.3	SUMMARY OF OTHER FIELD INVESTIGATIONS . . . . .	1-5
1.3.1	Summary of Previous Field Investigations . . . . .	1-5
1.3.2	Summary of BAAP Quarterly Groundwater Monitoring Data. . . . .	1-12
1.4	SITE IDENTIFICATION/REGULATORY OVERSIGHT . . . . .	1-13
1.5	REMEDIAL INVESTIGATION REPORT ORGANIZATION . . . . .	1-14
<b>2.0</b>	<b>BACKGROUND . . . . .</b>	<b>2-1</b>
2.1	LOCATION . . . . .	2-1
2.2	ENVIRONMENTAL SETTING . . . . .	2-1
2.2.1	Climate . . . . .	2-1
2.2.2	Physiography . . . . .	2-2
2.2.3	Geology and Hydrogeology . . . . .	2-3
2.2.3.1	Geology . . . . .	2-3
2.2.3.2	Hydrogeology . . . . .	2-5
2.2.4	Regional Groundwater Flow Model . . . . .	2-8
2.2.5	Background Analyte Concentrations . . . . .	2-13
2.2.5.1	Soils . . . . .	2-14
2.2.5.1.1	Surface Soils . . . . .	2-14
2.2.5.1.2	Subsurface Soils . . . . .	2-15
2.2.5.2	Groundwater . . . . .	2-16
2.2.5.3	Sediment . . . . .	2-17
2.2.5.4	Surface Water . . . . .	2-18
2.2.6	Land Use and Biotic Communities . . . . .	2-18
2.2.7	Basewide Ecological Resource Areas . . . . .	2-20
2.2.7.1	Identification of Wetland and Upland Areas . . . . .	2-20
2.2.7.2	Wetland Attributes and Functions . . . . .	2-22
2.2.7.3	Floodplain Assessment . . . . .	2-23



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
	2.2.7.4 Habitats of Special Concern and Endangered Species .....	2-23
2.3	HISTORY OF INDUSTRIAL OPERATIONS .....	2-24
3.0	APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS .....	3-1
3.1	DEFINITION OF ARARS .....	3-1
3.2	IDENTIFICATION OF ARARS .....	3-2
3.3	APPLICABILITY OF REGULATORY REQUIREMENTS AT FEDERAL FACILITIES .....	3-3
3.4	CURRENT REGULATORY STATUS OF SOLID WASTE MANAGEMENT UNITS AT BAAP .....	3-5
3.5	IDENTIFICATION OF LOCATION-SPECIFIC ARARS .....	3-5
3.6	IDENTIFICATION OF CHEMICAL-SPECIFIC ARARS .....	3-7
3.7	IDENTIFICATION OF ACTION-SPECIFIC ARARS. ....	3-12
4.0	HUMAN HEALTH EVALUATION .....	4-1
4.1	OVERVIEW AND SCOPE .....	4-1
4.2	IDENTIFICATION OF COMPOUNDS OF POTENTIAL CONCERN ..	4-1
4.3	EXPOSURE ASSESSMENT .....	4-3
	4.3.1 Land Use .....	4-3
	4.3.2 Populations Exposed .....	4-4
	4.3.3 Exposure Pathways Selected .....	4-6
	4.3.4 Quantification of Exposure .....	4-7
	4.3.5 Derivation of Exposure Point Concentrations .....	4-10
4.4	TOXICITY ASSESSMENT .....	4-12
4.5	RISK CHARACTERIZATION .....	4-14
4.6	EVALUATION OF UNCERTAINTY AND CONSERVATISM .....	4-17
5.0	BASELINE ECOLOGICAL RISK ASSESSMENT .....	5-1
5.1	SELECTION OF CHEMICALS OF CONCERN .....	5-2
5.2	IDENTIFICATION OF POTENTIAL ECOLOGICAL RECEPTORS ...	5-3



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
	5.2.1 Land Use and Biotic Communities .....	5-3
	5.2.2 Flora .....	5-5
	5.2.3 Fauna .....	5-6
	5.2.4 Habitats of Special Concern and Endangered Species ..	5-8
5.3	ECOLOGICAL EXPOSURE ASSESSMENT .....	5-9
	5.3.1 Aquatic Biota .....	5-10
	5.3.2 Terrestrial Biota .....	5-11
	5.3.2.1 Terrestrial Receptors .....	5-11
5.4	ECOTOXICITY ASSESSMENT .....	5-15
	5.4.1 Toxicity to Aquatic Receptors .....	5-15
	5.4.1.1 Surface Water .....	5-16
	5.4.1.2 Sediments .....	5-17
	5.4.2 Toxicity to Terrestrial Receptors .....	5-19
5.5	ECOLOGICAL RISK ASSESSMENT .....	5-20
	5.5.1 Risks to Aquatic Receptors .....	5-20
	5.5.1.1 Risks Associated with Surface Water Exposure .....	5-20
	5.5.1.2 Risks Associated with Sediment Exposure ..	5-20
	5.5.2 Risks to Terrestrial Receptors .....	5-21
5.6	ECOLOGICAL RISK ASSESSMENT UNCERTAINTIES AND DATA GAPS .....	5-22
	5.6.1 Uncertainties and Assumptions .....	5-22
6.0	PROPELLANT BURNING GROUND, LANDFILL NO. 1, SETTLING PONDS AND SPOILS DISPOSAL AREA .....	6-1
6.1	CURRENT AND PAST DISPOSAL PRACTICES .....	6-1
	6.1.1 Propellant Burning Ground .....	6-1
	6.1.2 Landfill 1 .....	6-6
	6.1.3 Settling Ponds and Spoils Disposal Area .....	6-7
	6.1.4 Interim Remedial Measure Facility History .....	6-9
6.2	FIELD PROGRAM DESCRIPTION AND RATIONALE .....	6-9
	6.2.1 Soil Vapor Survey .....	6-9
	6.2.2 Surface Soil Sampling .....	6-10
	6.2.3 Remote Sensing Geophysics .....	6-11



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
6.2.4	Test Pits and Soil Sampling .....	6-11
6.2.5	Soil Borings and Subsurface Soil Sampling .....	6-12
6.2.6	Monitoring Well Installations .....	6-13
6.2.7	Borehole Geophysics .....	6-16
6.2.8	Permeability Testing .....	6-17
6.2.9	Aquifer Pumping Test .....	6-18
6.2.10	Groundwater Sampling .....	6-20
6.2.11	Summary of Chemical Analysis Schedule .....	6-21
	6.2.11.1 Laboratory Analytical Program .....	6-21
	6.2.11.2 Field Testing .....	6-22
	6.2.11.3 Data Management .....	6-22
6.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION .....	6-23
6.3.1	Surface Water Hydrology .....	6-23
6.3.2	Geology .....	6-25
6.3.3	Hydrogeology of Unconsolidated Sediments .....	6-27
6.3.4	Groundwater Movement .....	6-29
6.3.5	Groundwater Flow Models .....	6-30
	6.3.5.1 Conceptual Setting .....	6-30
	6.3.5.2 Data Collection .....	6-31
	6.3.5.3 Preprocessor Description .....	6-31
	6.3.5.4 Model Description .....	6-31
	6.3.5.5 Box Model .....	6-31
	6.3.5.5.1 Model Parameters .....	6-32
	6.3.5.5.2 Calibration .....	6-32
	6.3.5.5.3 Sensitivity Analysis .....	6-33
	6.3.5.5.4 Results and Conclusions .....	6-33
	6.3.5.6 Propellant Burning Ground Model .....	6-33
	6.3.5.6.1 Model Parameters .....	6-33
	6.3.5.6.2 Model Calibration .....	6-34
	6.3.5.6.3 Sensitivity Analysis .....	6-35
	6.3.5.6.4 Results and Conclusions .....	6-35
6.4	NATURE AND EXTENT OF CONTAMINATION .....	6-36
6.4.1	Introduction .....	6-36
6.4.2	Contamination Assessment .....	6-38
	6.4.2.1 Soil Vapor Survey .....	6-38



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
	6.4.2.2 Geophysical Survey .....	6-39
	6.4.2.3 Surface Soil .....	6-40
	6.4.2.3.1 Propellant Burning Ground .....	6-40
	6.4.2.3.2 Settling Ponds and Spoils Disposal Area ...	6-46
	6.4.2.4 Subsurface Soil .....	6-52
	6.4.2.4.1 Propellant Burning Ground .....	6-52
	6.4.2.4.2 Landfill 1 .....	6-60
	6.4.2.4.3 Settling Ponds and Spoils Disposal Area ...	6-62
	6.4.2.5 Groundwater .....	6-64
	6.4.2.5.1 Volatile Organic Compounds .....	6-65
	6.4.2.5.2 Semivolatile Organic Compounds .....	6-72
	6.4.2.5.3 Inorganics (Metals and Anions) .....	6-74
	6.4.2.6 Environmental Fate of Contaminants .....	6-78
	6.4.3 Summary of Contamination .....	6-82
6.5	HUMAN HEALTH EVALUATION .....	6-84
	6.5.1 Propellant Burning Ground .....	6-84
	6.5.1.1 Chemicals of Potential Concern .....	6-84
	6.5.1.2 Exposure Point Concentrations .....	6-84
	6.5.1.3 Exposure Assessment .....	6-85
	6.5.1.4 Risk Characterization .....	6-85
	6.5.1.5 Summary of Risks at the Propellant Burning Ground .....	6-86
	6.5.2 Settling Ponds and Spoils Disposal Area .....	6-86
	6.5.2.1 Chemicals of Potential Concern .....	6-86
	6.5.2.2 Exposure Assessment .....	6-87
	6.5.2.3 Exposure Point Concentrations .....	6-87
	6.5.2.4 Risk Characterization .....	6-88
	6.5.2.5 Summary of Risks at the Settling Ponds and Spoils Disposal Area .....	6-91
	6.5.3 Evaluation of Groundwater Quality .....	6-91
	6.5.4 Discussion of Uncertainties .....	6-91
	6.5.5 Summary and Conclusions .....	6-91
6.6	BASELINE ECOLOGICAL ASSESSMENT .....	6-92
	6.6.1 Site Biological Characterizations .....	6-92
	6.6.1.1 Propellant Burning Ground .....	6-93



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

TABLE OF CONTENTS  
(continued)

Section	Title	Page No.
	6.6.1.2 Settling Ponds and Spoils Disposal Area . . .	6-93
6.6.2	Selection of Chemicals of Concern . . . . .	6-94
	6.6.2.1 Propellant Burning Ground and Landfill 1 .	6-94
	6.6.2.2 Settling Ponds and Spoils Disposal Area . . .	6-95
6.6.3	Ecological Risk Characterization . . . . .	6-96
	6.6.3.1 Risks to Aquatic and Semi-aquatic Receptors . . . . .	6-96
	6.6.3.2 Risks to Terrestrial Receptors . . . . .	6-97
6.6.4	Ecological Risk Assessment Conclusions . . . . .	6-99
	6.6.4.1 Effects on Aquatic Receptors . . . . .	6-99
	6.6.4.2 Effects on Terrestrial Receptors . . . . .	6-100
6.7	CONCLUSIONS OF THE BASELINE HUMAN HEALTH AND ECOLOGICAL EVALUATION . . . . .	6-100
	6.7.1 Propellant Burning Ground . . . . .	6-100
	6.7.2 Settling Ponds and Spoils Disposal Area . . . . .	6-101
	6.7.3 Groundwater . . . . .	6-101
7.0	DETERRENT BURNING GROUND AND EXISTING LANDFILL . . . . .	7-1
7.1	CURRENT AND PAST DISPOSAL PRACTICES . . . . .	7-1
	7.1.1 Deterrent Burning Ground . . . . .	7-1
	7.1.2 Existing Landfill . . . . .	7-3
7.2	FIELD PROGRAM DESCRIPTION AND RATIONALE . . . . .	7-5
	7.2.1 Soil Vapor Survey . . . . .	7-5
	7.2.2 Remote Sensing Geophysics . . . . .	7-6
	7.2.3 Soil Borings and Subsurface Soil Sampling . . . . .	7-7
	7.2.4 Monitoring Well Installations . . . . .	7-7
	7.2.5 Borehole Geophysics . . . . .	7-9
	7.2.6 Permeability Testing . . . . .	7-10
	7.2.7 Groundwater Sampling . . . . .	7-11
	7.2.8 Summary of Chemical Analysis Schedule . . . . .	7-12
	7.2.8.1 Laboratory Analytical Program . . . . .	7-12
	7.2.8.2 Field Testing . . . . .	7-13
	7.2.8.3 Data Management . . . . .	7-13



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
7.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION . . . . .	7-14
7.3.1	Surface Water Hydrology . . . . .	7-14
7.3.2	Geology . . . . .	7-15
7.3.3	Hydrogeology of Unconsolidated Sediments . . . . .	7-18
7.3.4	Groundwater Movement . . . . .	7-21
7.3.5	Summary . . . . .	7-25
7.4	NATURE AND EXTENT OF CONTAMINATION . . . . .	7-25
7.4.1	Introduction . . . . .	7-25
7.4.2	Contamination Assessment . . . . .	7-27
7.4.2.1	Soil Vapor Survey . . . . .	7-27
7.4.2.2	Geophysical Survey . . . . .	7-27
7.4.2.3	Subsurface Soil . . . . .	7-28
7.4.2.3.1	Volatile Organic Compounds . . . . .	7-29
7.4.2.3.2	Semivolatile Organic Compounds . . . . .	7-30
7.4.2.3.3	Inorganics (Metals and Anions) . . . . .	7-32
7.4.2.3.4	Interpretation of Subsurface Soil Data . . . . .	7-33
7.4.2.4	Groundwater . . . . .	7-34
7.4.2.4.1	Volatile Organic Compounds . . . . .	7-35
7.4.2.4.2	Semivolatile Organic Compounds and Nitrosamines . . . . .	7-36
7.4.2.4.3	Inorganics (Metals and Anions) . . . . .	7-36
7.4.2.4.4	pH and Specific Conductance . . . . .	7-39
7.4.2.4.5	Interpretation of Groundwater Data . . . . .	7-40
7.4.2.5	Environmental Fate of Contaminants . . . . .	7-43
7.4.2.6	Summary of Contamination . . . . .	7-44
7.5	HUMAN HEALTH EVALUATION . . . . .	7-46
7.5.1	Deterrent Burning Ground . . . . .	7-46
7.5.1.1	Identification of Compounds of Concern . . . . .	7-46
7.5.1.2	Exposure Point Concentrations . . . . .	7-46
7.5.1.3	Human Exposure Assessment . . . . .	7-46
7.5.1.4	Risk Characterization . . . . .	7-47
7.5.1.5	Summary of Risks at the Deterrent Burning Ground . . . . .	7-47
7.5.2	Existing Landfill . . . . .	7-48
7.5.3	Evaluation of Groundwater . . . . .	7-48



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

TABLE OF CONTENTS  
(continued)

Section	Title	Page No.
	7.5.4 Discussion of Uncertainties .....	7-48
	7.5.5 Summary .....	7-48
7.6	BASELINE ECOLOGICAL ASSESSMENT .....	7-49
	7.6.1 Site Biological Characterization .....	7-49
	7.6.2 Selection of Chemicals of Concern .....	7-50
	7.6.2.1 Deterrent Burning Ground .....	7-50
	7.6.2.2 Existing Landfill .....	7-50
	7.6.3 Ecological Risk Characterization .....	7-50
	7.6.4 Ecological Risk Assessment Conclusions .....	7-50
7.7	CONCLUSIONS OF THE BASELINE HUMAN HEALTH AND ECOLOGICAL EVALUATIONS .....	7-51
8.0	NITROGLYCERINE POND, ROCKET PASTE AREA, AND NEW ACID AREA .....	8-1
8.1	CURRENT AND PAST DISPOSAL PRACTICES .....	8-1
	8.1.1 Nitroglycerine Pond .....	8-1
	8.1.2 Rocket Paste Area .....	8-2
	8.1.3 New Acid Area .....	8-3
8.2	FIELD PROGRAM DESCRIPTION AND RATIONALE .....	8-4
	8.2.1 Sediment and Surface Water Sampling .....	8-4
	8.2.1.1 Nitroglycerine Pond .....	8-4
	8.2.1.2 Rocket Paste Area .....	8-5
	8.2.2 Monitoring Well Installations .....	8-6
	8.2.3 Permeability Testing .....	8-7
	8.2.4 Groundwater Sampling .....	8-7
	8.2.5 Summary of Chemical Analysis Schedule .....	8-8
	8.2.5.1 Laboratory Analytical Program .....	8-8
	8.2.5.2 Data Management .....	8-9
8.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION .....	8-10
	8.3.1 Surface Water Hydrology .....	8-10
	8.3.2 Geology .....	8-11
	8.3.3 Hydrogeology of Unconsolidated Sediments .....	8-12
	8.3.4 Groundwater Movement .....	8-13
8.4	NATURE AND EXTENT OF CONTAMINATION .....	8-14



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
8.4.1	Introduction . . . . .	8-14
8.4.2	Contamination Assessment . . . . .	8-15
	8.4.2.1 Surface Soils and Sediments . . . . .	8-16
	8.4.2.2 Surface Water . . . . .	8-21
	8.4.2.3 Groundwater . . . . .	8-23
8.4.3	Summary of Contamination Assessment . . . . .	8-25
8.5	HUMAN HEALTH EVALUATION . . . . .	8-26
8.5.1	Nitroglycerine Pond . . . . .	8-26
	8.5.1.1 Chemicals of Potential Concern . . . . .	8-26
	8.5.1.2 Human Exposure Levels . . . . .	8-26
	8.5.1.3 Exposure Point Concentrations . . . . .	8-27
	8.5.1.4 Risk Characterization . . . . .	8-27
	8.5.1.5 Summary of Risks at Nitroglycerine Pond . . . . .	8-29
8.5.2	Rocket Paste Area . . . . .	8-29
	8.5.2.1 Compounds of Potential Concern . . . . .	8-29
	8.5.2.2 Human Exposure Assessment . . . . .	8-29
	8.5.2.3 Exposure Point Concentrations . . . . .	8-30
	8.5.2.4 Risk Characterization . . . . .	8-30
	8.5.2.5 Summary of Risk at the Rocket Paste Area . . . . .	8-32
8.5.3	New Acid Area . . . . .	8-32
8.5.4	Evaluation of Groundwater Quality . . . . .	8-33
8.5.5	Discussion of Uncertainties . . . . .	8-33
8.5.6	Summary . . . . .	8-33
8.6	BASELINE ECOLOGICAL ASSESSMENT . . . . .	8-34
8.6.1	Site Biological Characterizations . . . . .	8-34
	8.6.1.1 Nitroglycerine Pond . . . . .	8-34
	8.6.1.2 Rocket Paste Area . . . . .	8-34
	8.6.1.3 New Acid Area . . . . .	8-35
8.6.2	Selection of Chemicals of Concern . . . . .	8-35
	8.6.2.1 Nitroglycerine Pond . . . . .	8-35
	8.6.2.2 Rocket Paste Area . . . . .	8-36
	8.6.2.3 New Acid Area . . . . .	8-36
8.6.3	Ecological Risk Characterization . . . . .	8-36
	8.6.3.1 Nitroglycerine Pond . . . . .	8-36
	8.6.3.2 Rocket Paste Area . . . . .	8-37



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
	8.6.3.3 New Acid Area .....	8-38
8.6.4	Ecological Risk Assessment Conclusions .....	8-38
	8.6.4.1 Effects on Aquatic Receptors .....	8-38
	8.6.4.2 Effects to Terrestrial Receptors .....	8-39
8.7	CONCLUSIONS OF THE BASELINE HUMAN HEALTH AND ECOLOGICAL ASSESSMENTS .....	8-39
	8.7.1 Nitroglycerine Pond .....	8-39
	8.7.2 Rocket Paste Area .....	8-40
	8.7.3 New Acid Area .....	8-40
	8.7.4 Groundwater .....	8-40
9.0	OLEUM PLANT, OLEUM PLANT POND, AND BALLISTICS POND .....	9-1
9.1	PAST DISPOSAL PRACTICES .....	9-1
9.2	FIELD PROGRAM DESCRIPTION AND RATIONALE .....	9-5
	9.2.1 Soil Borings and Subsurface Soil Sampling .....	9-5
	9.2.2 Monitoring Well Installations .....	9-6
	9.2.3 Permeability Testing .....	9-7
	9.2.4 Surface Water and Sediment Sampling .....	9-8
	9.2.4.1 Oleum Plant Pond .....	9-8
	9.2.4.2 Ballistics Pond .....	9-8
	9.2.5 Groundwater Sampling .....	9-9
	9.2.6 Summary of Chemical Analysis Schedule .....	9-10
	9.2.6.1 Laboratory Analytical Program .....	9-10
	9.2.6.2 Data Management .....	9-11
9.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION .....	9-12
	9.3.1 Surface Water Hydrology .....	9-12
	9.3.2 Geology .....	9-13
	9.3.3 Hydrogeology of Unconsolidated Sediments .....	9-15
	9.3.4 Groundwater Movement .....	9-19
9.4	NATURE AND EXTENT OF CONTAMINATION .....	9-19
	9.4.1 Introduction .....	9-19
	9.4.2 Contamination Assessment .....	9-21



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
	9.4.2.1 Subsurface Soil Samples - Oleum Plant and Oleum Plant Pond . . . . .	9-21
	9.4.2.2 Sediment Samples - Oleum Plant and Oleum Plant Pond . . . . .	9-23
	9.4.2.3 Sediment Samples - Ballistics Pond . . . . .	9-23
	9.4.2.4 Surface Water - Ballistics Pond . . . . .	9-24
	9.4.2.5 Groundwater Samples - Oleum Plant, Oleum Plant Pond, and Ballistics Pond . . . . .	9-25
	9.4.3 Summary of Contamination . . . . .	9-27
9.5	HUMAN HEALTH EVALUATION . . . . .	9-27
	9.5.1 Oleum Plant and Oleum Plant Pond . . . . .	9-27
	9.5.1.1 Chemicals of Potential Concern . . . . .	9-28
	9.5.1.2 Exposure Assessment . . . . .	9-28
	9.5.1.3 Exposure Point Concentrations . . . . .	9-28
	9.5.1.4 Risk Characterization . . . . .	9-28
	9.5.1.5 Summary of Risks at the Oleum Plant and Pond . . . . .	9-29
	9.5.2 Ballistics Pond . . . . .	9-29
	9.5.2.1 Chemicals of Potential Concern . . . . .	9-30
	9.5.2.2 Exposure Point Concentrations . . . . .	9-30
	9.5.2.3 Exposure Assessment . . . . .	9-30
	9.5.2.4 Risk Characterization . . . . .	9-30
	9.5.3 Evaluation of Groundwater Contamination . . . . .	9-31
	9.5.4 Discussion of Uncertainties . . . . .	9-31
	9.5.5 Summary . . . . .	9-31
9.6	BASELINE ECOLOGICAL ASSESSMENT . . . . .	9-31
	9.6.1 Site Biological Characterizations . . . . .	9-32
	9.6.1.1 Oleum Plant and Oleum Plant Pond . . . . .	9-32
	9.6.1.2 Ballistics Pond . . . . .	9-32
	9.6.2 Selection of Chemicals of Concern . . . . .	9-33
	9.6.2.1 Oleum Plant and Oleum Plant Pond . . . . .	9-33
	9.6.2.2 Ballistics Pond . . . . .	9-33
	9.6.3 Ecological Risk Characterization . . . . .	9-33
	9.6.3.1 Oleum Plant and Oleum Plant Pond . . . . .	9-33
	9.6.3.2 Ballistics Pond . . . . .	9-34



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
9.6.4	Ecological Risk Assessment Conclusions . . . . .	9-34
9.6.4.1	Effects to Aquatic Receptors . . . . .	9-34
9.6.4.2	Effects to Terrestrial Receptors . . . . .	9-34
9.7	CONCLUSIONS OF THE BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS . . . . .	9-35
9.7.1	Oleum Plant and Oleum Plant Pond . . . . .	9-35
9.7.2	Ballistics Pond . . . . .	9-35
9.7.3	Groundwater . . . . .	9-35
10.0	OLD ACID AREA, OLD FUEL OIL TANK AREA . . . . .	10-1
10.1	CURRENT AND PAST DISPOSAL PRACTICES . . . . .	10-1
10.2	FIELD PROGRAM DESCRIPTION AND RATIONALE . . . . .	10-2
10.2.1	Soil Borings and Subsurface Soil Sampling . . . . .	10-2
10.2.2	Monitoring Well Installations . . . . .	10-3
10.2.3	Permeability Testing . . . . .	10-4
10.2.4	Groundwater Sampling . . . . .	10-5
10.2.5	Summary of Chemical Analysis Schedule . . . . .	10-6
10.2.5.1	Laboratory Analytical Program . . . . .	10-6
10.2.5.2	Data Management . . . . .	10-7
10.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION . . . . .	10-7
10.3.1	Surface Water Hydrology . . . . .	10-8
10.3.2	Geology . . . . .	10-8
10.3.3	Hydrogeology of Unconsolidated Sediments . . . . .	10-9
10.3.4	Groundwater Movement . . . . .	10-10
10.4	NATURE AND EXTENT OF CONTAMINATION . . . . .	10-11
10.4.1	Introduction . . . . .	10-11
10.4.2	Contamination Assessment . . . . .	10-12
10.4.2.1	Surface and Subsurface Soils . . . . .	10-12
10.4.2.2	Groundwater . . . . .	10-14
10.5	HUMAN HEALTH EVALUATION . . . . .	10-17
10.5.1	Old Acid Area . . . . .	10-17
10.5.1.1	Chemicals of Potential Concern . . . . .	10-17
10.5.1.2	Exposure Assessment . . . . .	10-17
10.5.1.3	Exposure Point Concentrations . . . . .	10-17



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
	10.5.1.4 Risk Characterization . . . . .	10-17
	10.5.1.5 Summary of Risks at the Old Acid Area . . .	10-18
10.5.2	Old Fuel Oil Tank . . . . .	10-18
	10.5.2.1 Chemicals of Potential Concern . . . . .	10-19
	10.5.2.2 Human Exposure Levels . . . . .	10-19
	10.5.2.3 Exposure Point Concentrations . . . . .	10-19
	10.5.2.4 Risk Characterization . . . . .	10-19
	10.5.2.5 Summary of Risks at the Old Fuel Oil Tank . . . . .	10-20
10.5.3	Evaluation of Groundwater . . . . .	10-20
10.5.4	Discussion of Uncertainties . . . . .	10-20
10.5.5	Summary . . . . .	10-20
10.6	BASELINE ECOLOGICAL ASSESSMENT . . . . .	10-20
10.6.1	Site Biological Characterizations . . . . .	10-21
10.6.2	Selection of Chemicals of Concern . . . . .	10-21
	10.6.2.1 Old Acid Area . . . . .	10-21
	10.6.2.2 Old Fuel Oil Tank Area . . . . .	10-21
10.6.3	Ecological Risk Characterization . . . . .	10-21
	10.6.3.1 Old Acid Area . . . . .	10-22
10.6.4	Ecological Risk Assessment Conclusions . . . . .	10-22
10.7	CONCLUSIONS OF THE BASELINE HUMAN HEALTH AND ECOLOGICAL ASSESSMENTS . . . . .	10-23
10.7.1	Old Acid Area . . . . .	10-23
10.7.2	Old Fuel Oil Tank . . . . .	10-23
10.7.3	Groundwater . . . . .	10-23
11.0	OFF-POST AREA SOUTH OF BAAP . . . . .	11-1
11.1	INTRODUCTION . . . . .	11-1
11.2	FIELD PROGRAM DESCRIPTION AND RATIONALE . . . . .	11-1
	11.2.1 Monitoring Well Installations . . . . .	11-1
	11.2.2 Permeability Testing . . . . .	11-3
	11.2.3 Groundwater Sampling . . . . .	11-4
	11.2.4 Summary of Chemical Analysis Schedule . . . . .	11-5
	11.2.4.1 Laboratory Analytical Program . . . . .	11-5



# REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT

## TABLE OF CONTENTS (continued)

Section	Title	Page No.
	11.2.4.2 Data Management .....	11-5
11.3	GEOLOGY AND GROUNDWATER CHARACTERIZATION .....	11-6
	11.3.1 Geology .....	11-6
	11.3.2 Hydrogeology of Unconsolidated Sediments .....	11-7
11.4	NATURE AND EXTENT OF CONTAMINATION .....	11-9
	11.4.1 Introduction .....	11-9
	11.4.2 Contamination Assessment .....	11-10
	11.4.2.1 Groundwater Data from Private Wells ....	11-10
	11.4.2.2 Groundwater Data from Monitoring Wells .	11-13
	11.4.2.2.1 Volatile Organic Compounds .....	11-13
	11.4.2.2.2 Semivolatile Organic Compounds .....	11-14
	11.4.2.2.3 Inorganics (Metals and Anions) .....	11-15
	11.4.3 Summary of Contamination .....	11-16
	11.4.4 Environmental Fate of Contaminants .....	11-17
	11.4.5 Model of Groundwater Contaminant Transport .....	11-18
11.5	HUMAN HEALTH EVALUATION .....	11-20
11.6	BASELINE ECOLOGICAL ASSESSMENT .....	11-21
11.7	CONCLUSIONS OF BASELINE HUMAN HEALTH AND ECOLOGICAL ASSESSMENTS .....	11-22
12.0	SUMMARY AND CONCLUSIONS OF BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS .....	12-1
12.1	SUMMARY OF BASELINE HUMAN HEALTH RISK ASSESSMENT .....	12-1
12.2	SUMMARY OF ECOLOGICAL RISK ASSESSMENT .....	12-3
12.3	CONCLUSIONS .....	12-7

### GLOSSARY OF ACRONYMS AND ABBREVIATIONS

LIST OF USATHAMA CHEMICAL CODES - Listed by Analyte Acronym

LIST OF USATHAMA CHEMICAL CODES - Listed by Analyte Name

UNIFIED SOIL CLASSIFICATION SYSTEM DESCRIPTIONS



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
<b>REFERENCES</b>		
<b>APPENDICES (bound separately in 7 volumes)</b>		
APPENDIX A -	LOCATION-SPECIFIC AND CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS	Vol. 1
APPENDIX B -	SOIL VAPOR SURVEY	Vol. 1
APPENDIX C -	SURFACE GEOPHYSICAL SURVEY	Vol. 1
APPENDIX D -	DRILLING AND SOIL SAMPLING PROGRAM	Vol. 1
	D.1 Test Pit, Soil Boring, and Monitoring Wells Boring Logs	Vol. 1
	D.2 Field Data Records - Soil, Sediments, and Surface Water	Vol. 2
	D.3 Monitoring Well Construction Diagrams	Vol. 2
	D.4 Well Development Records	Vol. 2
	D.5 Regional Water Supply Well Logs	Vol. 2
APPENDIX E -	BOREHOLE GEOPHYSICAL SURVEY	Vol. 2
APPENDIX F -	HORIZONTAL AND VERTICAL SURVEY	Vol. 2
APPENDIX G -	GROUNDWATER ELEVATIONS AND FIELD DATA RECORDS	Vol. 3
	G.1 Groundwater Elevation Data	Vol. 3
	G.2 Field Data Records - Round I and II	Vol. 3
	G.3 Field Data Records - Round One	Vol. 3
	G.4 Field Data Records - Round Two	Vol. 3
	G.5 Field Data Records - BAAP Production Well No. 2	Vol. 3
APPENDIX H -	HYDROGEOLOGIC DATA	Vol. 3
	H.1 Recharge Estimates	Vol. 3
	H.2 Gradient Calculations	Vol. 3



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**TABLE OF CONTENTS  
(continued)**

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
	H.3 Velocity Calculations	Vol. 3
	H.4 Preliminary Aquifer Test Results IRM	Vol. 3
	H.5 High Capacity Well Survey	Vol. 3
	H.6 Production Well No. 4 Zone-of-Influence	Vol. 3
APPENDIX I -	HYDRAULIC CONDUCTIVITY TEST RESULTS	Vol. 3
APPENDIX J -	AQUIFER TESTING AND MODELING	Vol. 3
	J.1 Aquifer Pumping Test	Vol. 3
	J.2 Regional Groundwater Flow Model	Vol. 3
	J.3 Propellant Burning Ground Groundwater Flow Model	Vol. 3
APPENDIX K -	CHEMICAL DATA TABLES	Vol. 4
	K.1 Flagging Codes for Chemical Data Tables	Vol. 4
	K.2 Soil Data - Surface, Subsurface, and Sediment	Vol. 4
	K.3 Surface Water Data	Vol. 4
	K.4 Groundwater Data - Round I (September 1990) and Round II (October 1990)	Vol. 4
	K.5 Groundwater Data - Round One (November/ December 1991) and Round Two (April/May 1992)	Vol. 5
APPENDIX L -	DATA QUALITY REPORT	Vol. 6
	L.1 BAAP Production Well No. 2 Water Quality Assessment	Vol. 6
	L.2 USATHAMA-certified Analytical Methods	Vol. 6
	L.3 Laboratory Quality Control Data	Vol. 6
	L.4 Summary of Nontarget, Library Searched Compounds Detected in RI Analytical Program	Vol. 6
	L.5 USATHAMA-approved Laboratory Control Charts	Vol. 6
	L.6 ABB-ES Groundwater Screening Results	Vol. 6
	L.7 Selection of Analytical Results In the Case of More Than One Analytical Method	Vol. 6
	L.8 USATHAMA/USEPA Split Groundwater Samples	Vol. 6
APPENDIX M -	CALCULATIONS FOR PARAMETERS USED IN RISK ASSESSMENT	Vol. 7



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

TABLE OF CONTENTS  
(continued)

<u>Section</u>	<u>Title</u>	<u>Page No.</u>
APPENDIX N -	IRIS FILES FOR COMPOUNDS OF POTENTIAL CONCERN	Vol. 7
APPENDIX O -	HUMAN HEALTH RISK CALCULATIONS	Vol. 7
APPENDIX P -	INVENTORY OF SITE SPECIES	Vol. 7
APPENDIX Q -	EXPOSURE PARAMETERS OF SITE SPECIES	Vol. 7
APPENDIX R -	ECOLOGICAL RISK CALCULATIONS	Vol. 7



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(Provided in Text Volume II)**

<b>Table</b>	<b>Title</b>
1-1	Summary of Previous Field Investigations
2-1	Location and Current Use of BAAP Production Wells
2-2	Summary of Borings/Monitoring Wells Installed - Background Areas
2-3	Background Metals Concentrations in Surface Soil
2-4	Background Analyte Concentrations in Subsurface Soil
2-5	TCLP Metals Data Summary for Subsurface Soil - Background Borings
2-6	Summary of Average Background Groundwater Quality Data - Background Areas
2-7	Background Sediment Concentrations - Regional
2-8	Background Sediment Concentrations - Control Pond
3-1	Checklist of SWMU Features
3-2	Potential Location-Specific Applicable or Relevant and Appropriate Requirements
3-3	Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
3-4	Chemical Specific Standards and Guidance
3-5	Potential Action - Specific Applicable or Relevant and Appropriate Requirements
4-1	Exposure Pathways - Current and Future Land Use



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
4-2	Equations Used to Estimate Chemical Intake
4-3	Exposure Parameters - Occupational/Recreational Contact with Soil and Sediment
4-4	Exposure Parameters - Future Residential Surface Soil Contact
4-5	Recreational Contact with Surface Water
4-6	Oral Dose-Response Information for Noncarcinogenic Effects
4-7	Oral Dose-Response Information for Carcinogenic Effects
4-8	Inhalation Dose-Response Information for Carcinogenic Effects
4-9	Inhalation Dose-Response Information for Noncarcinogenic Effects
4-10	Potential Sources of Uncertainty for Risk Assessment
5-1	Primary Routes of Exposure for Ecological Receptors
5-2	Summary of Exposure Pathways Evaluated in the Area
5-3	Reference Toxicity Values for Aquatic Receptors - Surface Water
5-4	Reference Toxicity Values for Aquatic Receptors - Sediment
5-5	Summary of Reference Toxicity Values for Terrestrial Receptors
6-1	Summary of the Remedial Investigation Field Program - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-2	Summary of Borings Completed - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
6-3	Summary of Monitoring Wells and Piezometers Installed - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-4	Summary of Monitoring Wells Logged with Borehole Geophysics - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-5	Aquifer Pumping Test - Summary of Drawdown and Recovery Analyses - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-6	Wells Included in Groundwater Sampling Program - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-7	Chemical Analyses Performed on Surface Soil and Sediment Samples - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-8	Chemical Analyses Performed on Subsurface Soil Samples - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-9	Chemical Analyses Performed on Groundwater Samples - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-10	Vertical Groundwater Gradients - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-11	Horizontal Groundwater Gradients - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
6-12	Field Hydraulic Conductivity Test Results - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-13	Summary of Surface Soil Chemical Data - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-14	Summary of TCLP Metals Data for Surface Soil - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-15	Summary of Surface Soil Chemical Data - Settling Ponds and Spoils Disposal Area
6-16	Summary of Subsurface Soil Chemical Data - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-17	Summary of TCLP Metals Data for Subsurface Soil - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-18	Summary of Subsurface Soil Chemical Data from Previous Programs - Settling Ponds
6-19	Summary of Groundwater Chemical Data - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-20	Chemical and Physical Properties of Major Organic Contaminants - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Areas
6-21	Compounds of Potential Concern - Propellant Burning Ground
6-22	Summary of Risk Estimates - Propellant Burning Ground



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
6-23	Compounds of Potential Concern - Settling Ponds and Spoils Disposal Area
6-24	Summary of Risk Estimates - Settling Ponds and Spoils Disposal Area
6-25	Comparison of Groundwater to Standards - Propellant Burning Ground/Landfill 1/Settling Ponds and Spoils Disposal Area
6-26	Ecological Contaminants of Concern - Propellant Burning Ground
6-27	Ecological Contaminants of Concern - Final Creek Area
6-28	Ecological Contaminants of Concern - Settling Pond 1
6-29	Ecological Contaminants of Concern - Settling Pond 2
6-30	Ecological Contaminants of Concern - Settling Pond 3
6-31	Ecological Contaminants of Concern - Settling Pond 4
6-32	Ecological Contaminants of Concern - Spoils Disposal Area 1
6-33	Ecological Contaminants of Concern - Spoils Disposal Area 2
6-34	Ecological Contaminants of Concern - Spoils Disposal Area 3
6-35	Ecological Contaminants of Concern - Spoils Disposal Area 4
6-36	Ecological Contaminants of Concern - Spoils Disposal Area 5
6-37	Summary of Risk Evaluation for Terrestrial Receptors - Propellant Burning Ground



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

LIST OF TABLES  
(continued)

Table	Title
6-38	Summary of Risk Evaluation for Terrestrial Receptors - Settling Ponds and Spoils Disposal Area
7-1	Summary of the Remedial Investigation Field Program - Deterrent Burning Ground/Existing Landfill
7-2	Summary of Borings Completed - Deterrent Burning Ground/Existing Landfill
7-3	Chemical Analyses Performed on Subsurface Soil Samples - Deterrent Burning Ground/Existing Landfill
7-4	Summary of Monitoring Wells Installed - Deterrent Burning Ground/Existing Landfill
7-5	Summary of Monitoring Wells Logged with Borehole Geophysics - Deterrent Burning Ground/Existing Landfill
7-6	Wells Included in Groundwater Sampling Program - Deterrent Burning Ground/Existing Landfill
7-7	Chemical Analyses Performed on Groundwater Samples - Deterrent Burning Ground/Existing Landfill
7-8	Elevation of Glaciolacustrine Unit - Deterrent Burning Ground/Existing Landfill
7-9	Vertical Groundwater Gradients - Deterrent Burning Ground/Existing Landfill
7-10	Field Hydraulic Conductivity Test Results - Deterrent Burning Ground/Existing Landfill
7-11	Horizontal Groundwater Gradients - Deterrent Burning Ground/Existing Landfill



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

LIST OF TABLES  
(continued)

Table	Title
7-12	Summary of Subsurface Soil Chemical Data - Deterrent Burning Ground/Existing Landfill
7-13	Summary of TCLP Metals Data for Subsurface Soil - Deterrent Burning Ground
7-14	Summary of Groundwater Chemical Data - Deterrent Burning Ground/Existing Landfill
7-15	Chemical and Physical Properties of Major Organic Contaminants - Deterrent Burning Ground/Existing Landfill
7-16	Estimates of Distances Traveled by Organic Contaminants in Groundwater
7-17	Compounds of Potential Concern - Deterrent Burning Ground
7-18	Summary of Risk Estimates - Deterrent Burning Ground
7-19	Comparison of Groundwater to Standards - Deterrent Burning Ground/Existing Landfill
8-1	History of Acid Spills - New Acid Area
8-2	Summary of the Remedial Investigation Field Program - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-3	Summary of Monitoring Wells Installed - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-4	Field Hydraulic Conductivity Test Results - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-5	Wells Included In Groundwater Sampling Program - Nitroglycerine Pond/Rocket Paste Area/New Acid Area



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

LIST OF TABLES  
(continued)

Table	Title
8-6	Chemical Analyses Performed on Surface Soil and Sediment Samples - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-7	Chemical Analyses Performed on Surface Water Samples - Nitroglycerine Pond/Rocket Paste Pond
8-8	Chemical Analyses Performed on Groundwater Samples - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-9	Summary of Surface Soil and Sediment Chemical Data - Nitroglycerine Pond/Rocket Paste Area
8-10	Summary of Surface Water Chemical Data - Nitroglycerine Pond/Rocket Paste Area
8-11	Summary of Groundwater Chemical Data - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-12	TCLP Metals Data Summary Concentration in Sediment - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-13	Compounds of Potential Concern - Nitroglycerine Pond
8-14	Summary of Risk Estimates - Nitroglycerine Pond
8-15	Compounds of Potential Concern - Rocket Paste Area
8-16	Summary of Risk Estimates - Rocket Paste Area
8-17	Comparison of Groundwater to Standards - Nitroglycerine Pond/Rocket Paste Area/New Acid Area
8-18	Ecological Contaminants of Concern - Nitroglycerine Pond
8-19	Ecological Contaminants of Concern - Rocket Paste Area



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<u>Table</u>	<u>Title</u>
8-20	Risk Evaluation for Aquatic Receptors - Nitroglycerine Pond
8-21	Summary of Risk Evaluation for Terrestrial Receptors - Nitroglycerine Pond
8-22	Risk Evaluation for Aquatic Receptors - Rocket Paste Area
8-23	Summary of Risk Evaluation for Terrestrial Receptors - Rocket Paste Area
9-1	Summary of the Remedial Investigation Field Program - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-2	Summary of Borings Completed - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-3	Summary of Monitoring Wells Installed - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-4	Wells Included in Groundwater Sampling Program - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-5	Chemical Analyses Performed on Surface Water Analyses - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-6	Chemical Analyses Performed on Surface Soil and Sediment Samples - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-7	Chemical Analyses Performed on Subsurface Soil Samples - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-8	Chemical Analyses Performed on Groundwater Samples - Oleum Plant and Oleum Plant Pond/Ballistics Pond



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
9-9	Field Hydraulic Conductivity Test Results - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-10	Horizontal Groundwater Gradients - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-11	Summary of Subsurface Soil Chemical Data - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-12	Summary of Sediment Chemical Data - Oleum Plant and Oleum Plant Pond/ Ballistics Pond
9-13	Summary of Surface Water Chemical Data - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-14	Summary of Groundwater Chemical Data - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-15	Compounds of Potential Concern - Oleum Plant and Oleum Plant Pond
9-16	Summary of Risk Estimates - Oleum Plant and Oleum Plant Pond
9-17	Compounds of Potential Concern - Ballistics Pond
9-18	Summary of Risk Estimates - Ballistics Pond
9-19	Comparison of Groundwater to Standards - Oleum Plant and Oleum Plant Pond/Ballistics Pond
9-20	Ecological Contaminants of Concern - Oleum Plant and Oleum Plant Pond
9-21	Ecological Contaminants of Concern - Ballistics Pond



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<u>Table</u>	<u>Title</u>
9-22	Risk Evaluation for Aquatic Receptors - Oleum Plant Pond
9-23	Summary of Risk Evaluation for Terrestrial Receptors - Oleum Plant
9-24	Risk Evaluation for Aquatic Receptors - Ballistics Pond
10-1	History of Acid and Fuel Oil Spills - Old Acid Area/Old Fuel Oil Tank
10-2	Summary of the Remedial Investigation Field Program - Old Acid Area/Old Fuel Oil Tank
10-3	Summary of Borings Completed - Old Acid Area/Old Fuel Oil Tank
10-4	Summary of Monitoring Wells Installed - Old Acid Area/Old Fuel Oil Tank
10-5	Wells Included in Groundwater Sampling Program - Old Acid Area/Old Fuel Oil Tank
10-6	Chemical Analyses Performed on Subsurface Soil Samples - Old Acid Area/Old Fuel Oil Tank
10-7	Chemical Analyses Performed on Groundwater Samples - Old Acid Area/Old Fuel Oil Tank
10-8	Field Hydraulic Conductivity Test Results - Old Acid Area/Old Fuel Oil Tank
10-9	Summary of Subsurface Soil Chemical Data - Old Acid Area/Old Fuel Oil Tank



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<u>Table</u>	<u>Title</u>
10-10	Summary of Groundwater Chemical Data - Old Acid Area/Old Fuel Oil Tank
10-11	Compounds of Potential Concern - Old Acid Area
10-12	Summary of Risk Estimates - Old Acid Area
10-13	Compounds of Potential Concern - Old Fuel Oil Tank
10-14	Summary of Risk Estimates - Old Fuel Oil Tank
10-15	Comparison of Groundwater to Standards - Old Acid Area/Old Fuel Oil Tank
10-16	Ecological Contaminants of Concern - Old Acid Area
10-17	Summary of Risk Evaluation for Terrestrial Receptors - Old Acid Area
11-1	Summary of the Remedial Investigation Field Program - Off-Post Area South of BAAP
11-2	Summary of Monitoring Wells Installed - Off-Post Area South of BAAP
11-3	Wells Included in Groundwater Sampling Program - Off-Post Area South of BAAP
11-4	Chemical Analyses Performed on Groundwater Samples - Off-Post Area South of BAAP/Private Wells
11-5	Field Hydraulic Conductivity Test Results - Off-Post Area South of BAAP



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF TABLES  
(continued)**

<b>Table</b>	<b>Title</b>
11-6	Summary of Groundwater Chemical Data - Off-Post Area South of BAAP
11-7	Summary of Groundwater Chemical Data - Private Wells
11-8	Chemical and Physical Properties of VOCs Detected in Groundwater - Off-Post Area South of BAAP
11-9	Estimate of Distance Traveled by CCL4 in Groundwater - Off-Post Area South of BAAP
11-10	Comparison of Groundwater to Standards - Off-Post Area South of BAAP
12-1	Summary of Areas for which Remedial Action Objectives are Recommended



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(Provided in Text Volume II)**

<b>Figure</b>	<b>Title</b>
1-1	Site Location Map - Badger Army Ammunition Plant
1-2	Location of 11 Priority Sites - Badger Army Ammunition Plant
1-3	Monitoring Wells Sampled During the Remedial Investigation
2-1	Location of Terminal Moraine
2-2	Bedrock Surface Contour Plan - Badger Army Ammunition Plant
2-3	Regional Water Table Contour Plan - Badger Army Ammunition Plant
2-4	Regional Water Supply and Irrigation Wells - Badger Army Ammunition Plant
2-5	Location of BAAP Production Wells
2-6	Groundwater Flow Model Grid
2-7	Modeled Water Table Contour Plan
2-8	Background Surface Soil, Subsurface Soil and Monitoring Well Locations - Badger Army Ammunition Plant
2-9	Land Use Classification - Badger Army Ammunition Plant
6-1	Site Plan - Propellant Burning Ground and Landfill 1
6-2	Chronological Evolution of the Propellant Burning Ground
6-3	Site Plan - Settling Ponds and Spoils Disposal Areas
6-4	Approximate Petrex Soil Gas Sample Locations
6-5	Surface Soil Sample Locations at the Racetrack - Propellant Burning Ground



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<u>Figure</u>	<u>Title</u>
6-6	Surface Soil Sample Locations in the Contaminated Waste Area - Propellant Burning Ground
6-7	Geophysical Survey Area - 1949 Pit Area/Propellant Burning Ground
6-8	Geophysical Survey Area - Landfill 1
6-9	Exploration Locations - Propellant Burning Ground and Landfill 1
6-10	Exploration Locations - Settling Ponds and Spoils Disposal Areas
6-11	Monitoring Well Locations - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-12	Location of Extraction Wells, Monitoring Wells, and Piezometers Aquifer Pumping Test - Propellant Burning Ground
6-13	Location and Orientation of Geologic Cross Sections - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-14	Geologic Cross Section A-A' - Propellant Burning Ground, Settling Ponds and Spoils Disposal Area
6-15	Geologic Cross Section B-B' - Propellant Burning Ground, Settling Ponds and Spoils Disposal Area
6-16	Geologic Cross Section C-C' - Propellant Burning Ground, Settling Ponds and Spoils Disposal Area
6-17	Interpretive Water Table Contour Plan - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-18	Box Model Layers
6-19	Box Model Grid



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<b>Figure</b>	<b>Title</b>
6-20	Propellant Burning Ground Model Grid
6-21	Propellant Burning Ground Model Layers
6-22	Modeled Water Table Contour Plan - Propellant Burning Ground Model
6-23	Distribution of 24DNT, C6H6, and NNDPA in Surface Soils at the Race Track - Propellant Burning Ground
6-24	Interpretive PB Distribution in Surface Soils at the Racetrack Area - Propellant Burning Ground
6-25	Interpretive PB Distribution in Surface Soils at the Contaminated Waste Area - Propellant Burning Ground
6-26	Interpretive TCLP PB Distribution in Surface Soils at the Racetrack Area - Propellant Burning Ground
6-27	Interpretive TCLP PB Distribution in Surface Soils in the Contaminated Waste Area - Propellant Burning Ground
6-28	Summary of Selected Inorganic and SVOC Data for Surface Soils - Settling Ponds and Spoils Disposal Area
6-29	Interpretive C6H6 Concentrations in Subsurface Soils - Propellant Burning Ground Waste Pits
6-30	Interpretive TRCLE Concentrations in Subsurface Soils - Propellant Burning Ground Waste Pits
6-31	Interpretive Total DNT Concentrations in Subsurface Soils - Propellant Burning Ground Waste Pits
6-32	Summary of Selected VOC Groundwater Data- Propellant Burning Ground and Landfill 1



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<u>Figure</u>	<u>Title</u>
6-33	Interpretive Plan View of CCL4 Plume - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-34	Interpretive Plan View of TRCLE Plume - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-35	Orientation of Contaminant Plume Cross Sections A-A'- Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-36	Contaminant Plume Cross Section CCL4 - Propellant Burning Ground, Settling Ponds and Spoils Disposal Area
6-37	Contaminant Plume Cross Section TRCLE - Propellant Burning Ground, Settling Ponds and Spoils Disposal Area
6-38	26DNT and NNDPA Detected in Groundwater - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
6-39	NIT Concentrations in Groundwater - Propellant Burning Ground, Landfill 1, Settling Ponds and Spoils Disposal Area
7-1	Site Location Plan and Soil Boring and Monitoring Well Locations - Deterrent Burning Ground and Existing Landfill
7-2	Chronological Evolution of the Deterrent Burning Ground
7-3	Location of Previous Explorations - Deterrent Burning Ground and Existing Landfill
7-4	Chronological Evolution of the Existing Landfill
7-5	Petrex Soil Gas Sample Locations - Deterrent Burning Ground
7-6	Geophysical Survey Area - Deterrent Burning Ground



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<u>Figure</u>	<u>Title</u>
7-7	Location and Orientation of Geologic Cross Sections - Deterrent Burning Ground and Existing Landfill
7-8	Geologic Cross Section D-D' - Deterrent Burning Ground and Existing Landfill
7-9	Geologic Cross Section E-E' - Deterrent Burning Ground and Existing Landfill
7-10	Geologic Cross Section F-F' - Deterrent Burning Ground and Existing Landfill
7-11	Geologic Cross Section G-G' - Deterrent Burning Ground and Existing Landfill
7-12	Geologic Cross Section H-H' - Deterrent Burning Ground and Existing Landfill
7-13	Geologic Cross Section I-I' - Deterrent Burning Ground and Existing Landfill
7-14	Interpretive Top of Clay/Silt (Glaciolacustrine Layer) - Deterrent Burning Ground and Existing Landfill
7-15	Interpretive Perched Water Table Contour Plan - Deterrent Burning Ground and Existing Landfill
7-16	Interpretive Deep Potentiometric Surface Contour Plan - Deterrent Burning Ground and Existing Landfill
7-17	Regional Groundwater Contour Map - Deterrent Burning Ground and Existing Landfill
7-18	Production Well No. 4 - Zone of Influence - Deterrent Burning Ground and Existing Landfill



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<u>Figure</u>	<u>Title</u>
7-19	Total C6H6 Concentrations in Subsurface Soils - Deterrent Burning Ground Waste Pits
7-20	Total DNTs Concentrations in Subsurface Soils - Deterrent Burning Ground Waste Pits
7-21	NNDPA Concentrations in Subsurface Soils - Deterrent Burning Ground Waste Pits
7-22	VOC, SVOC, and NAM Distribution in Groundwater - Deterrent Burning Ground and Existing Landfill
7-23	Metals Distribution in Groundwater - Deterrent Burning Ground and Existing Landfill
7-24	SO4 Distribution in Groundwater - Deterrent Burning Ground and Existing Landfill
7-25	NIT Distribution in Groundwater - Deterrent Burning Ground and Existing Landfill
8-1	Site Location Plan and Sediment, Surface Soil, and Surface Water Sample Locations - Nitroglycerine Pond Area and Rocket Paste Area
8-2	Monitoring Well Locations and Orientation of Geologic Cross Section J-J' - Nitroglycerine Pond and Rocket Paste Area
8-3	Geologic Cross Section J-J' - Nitroglycerine Pond Area and Rocket Paste Area
8-4	Interpretive Water Table Contour Plan - Nitroglycerine Pond, Rocket Paste Area, and New Acid Area
8-5	NG Concentrations - Rocket Paste Area



**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

**LIST OF FIGURES  
(continued)**

<b>Figure</b>	<b>Title</b>
8-6	HG Concentrations - Rocket Paste Area
8-7	PB Concentrations - Rocket Paste Area
8-8	NNDPA Concentrations - Rocket Paste Area
8-9	Total DNT Concentrations - Rocket Paste Area
8-10	TCLP PB Concentrations - Rocket Paste Area
9-1	General Site Plan - Oleum Plant, Oleum Plant Pond and Ballistics Pond
9-2	Detailed Site Plan - Oleum Plant and Oleum Plant Pond
9-3	Detailed Site Plan - Ballistics Pond
9-4	Exploration Locations - Oleum Plant and Oleum Plant Pond
9-5	Surface Water and Sediment Samples - Ballistics Pond
9-6	Orientation of Geological Cross Sections - Oleum Plant, Oleum Plant Pond and Ballistics Pond
9-7	Geologic Cross Section - K-K' - Oleum Plant, Oleum Plant Pond and Ballistics Pond
9-8	Geologic Cross Section - L-L' - Oleum Plant, Oleum Plant Pond and Ballistics Pond
9-9	Geologic Cross Section - M-M' - Oleum Plant, Oleum Plant Pond and Ballistics Pond
9-10	Interpretive Groundwater Flow Directions - Oleum Plant, Oleum Plant Pond and Ballistics Pond



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

LIST OF FIGURES  
(continued)

Figure	Title
9-11	SO <sub>4</sub> Distribution in Subsurface Soils - Oleum Plant, Oleum Plant Pond and Ballistics Pond
10-1	Site Location Plan - Old Acid Area and Old Fuel Oil Tank
10-2	Soil Borings and Monitoring Well Locations - Old Acid Area and Old Fuel Oil Tank
10-3	Orientation of Geologic Cross Section N-N' - Old Acid Area and Old Fuel Oil Tank
10-4	Geologic Cross Section N-N' - Old Acid Area and Old Fuel Oil Tank
10-5	Water Table Contour Plan - Old Acid Area and Old Fuel Oil Tank
10-6	SO <sub>4</sub> Concentrations in Subsurface Soils - Old Acid Area
10-7	VOCs, CL, and SO <sub>4</sub> in Groundwater - Old Acid Area and Old Fuel Oil Tank
11-1	Site Location Plan and Monitoring Well Locations - Off-Post Area South of Badger Army Ammunition Plant
11-2	Location of Private Wells Sampled by ABB-ES
11-3	Location and Orientation of Geologic Cross Sections - Off-Post Area South of Badger Army Ammunition Plant
11-4	Geologic Cross Section O-O' - Off-Post Area South of Badger Army Ammunition Plant
11-5	Geologic Cross Section P-F' - Off-Post Area South of Badger Army Ammunition Plant
11-6	Geologic Cross Section Q-Q' - Off-Post Area South of Badger Army Ammunition Plant



REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

LIST OF FIGURES  
(continued)

<u>Figure</u>	<u>Title</u>
11-7	Interpretive Water Table Contour Plan - Off-Post Area South of Badger Army Ammunition Plant
11-8	Distribution of CHCL <sub>3</sub> , CCL <sub>4</sub> , and TRCLE in Groundwater - Off-Post Area South of Badger Army Ammunition Plant
11-9	Interpretive Plan View of VOC Plume - Off-Post Area South of Badger Army Ammunition Plant
11-10	CR, CD, and PB Distribution in Groundwater - Off-Post Area South of Badger Army Ammunition Plant



**TABLE 1-1**  
**SUMMARY OF PREVIOUS FIELD INVESTIGATIONS**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

PROGRAM ELEMENTS					
DATE	INVESTIGATIONS	SITES	MONITORING WELL INSTALLATIONS	SURFACE SOIL SAMPLING	SOIL BORINGS
1. 1977	U.S. AEHA	Rocket Paste Pond and Ditches	NA	Sediment and Paste Samples from Pond	Surface Water Samples from Pond
2. 1979	U.S. Army Corps of Engineers Mobile District	Existing Landfill	3 wells (S1134, S1135, S1136)	NA	NA
		Propellant Burning Ground	3 wells (S1144, S1145, S1146)	NA	NA
3. 1981	Envirodyne BAAP Contamination Survey	Distributed throughout BAAP	33 wells (S1101 through S1133)	2 sediment samples from NG Pond	NA
				2 sediment samples from Rocket Paste Ditch	
4. 1982	USAEHA Phase 2 Hazardous Waste Management Study	Propellant Burning Ground	NA	45 surface soil samples	NA
5. 1982	Warzyn Geological and Soils Survey and Groundwater Monitoring Program	Deterrent Burning Ground	4 wells (DBM-82-01, DBM-82-02, and DBN-82-01A,B)	NA	4 borings (DBB-82-01 through DBB-82-04)
		Propellant Burning Ground	20 wells: 5 sets of well nests, 3 wells per nest (PBN-82-01A,B,C through PBN-82-05A,B,C); 5 single wells (PBM-82-01 through PBM-82-05)	NA	8 borings (PBB-82-01 through PBB-82-08)
		Existing Landfill	12 wells: 4 sets of well nests, 3 wells per nest (ELN-82-01A,B,C through ELN-82-04A,B,C)	NA	6 borings (ELB-82-01 through ELB-82-06)
6. 1983	SARKO Establishment of Five Groundwater Monitoring Wells	Settling Ponds	3 wells (S-83-1147, S-83-1148, and S-83-1149) <sup>2</sup>	NA	NA
		Other Locations at BAAP	2 wells (S-83-1150 and S-83-1151) <sup>2</sup>	NA	NA



continued

TABLE 1-1  
SUMMARY OF PREVIOUS FIELD INVESTIGATIONS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

DATE	INVESTIGATIONS	SITES	PROGRAM ELEMENTS		
			MONITORING WELL INSTALLATIONS	SURFACE SOIL SAMPLING	SOIL BORINGS
7. 1984	Ayers Near-surface Soils Investigation	Final Creek and Settling Ponds Main Rocket Paste Drainage Ditch NG Pond and Overflow Pond	NA	50 surface soil samples 10 sediment samples from Main Rocket Paste Ditch 8 sediment samples	NA
8. 1984	Ayers Near-surface Soils Investigation	Ballistics Creek and Ballistics Pond	NA	5 creek sediment samples 4 pond sediment samples 2 surface soil samples	NA
9. 1984	Ayers Near-surface Soils Investigation	Oleum Plant and Pond Area	NA	8 soil/sediment samples 3 Control Pond sediment samples	NA
10. 1984	USAEHA Phase 4 Hazardous Waste Management Study	Propellant Burning Ground	NA	NA	15 soil borings to 50-foot depth; 70 subsurface soil samples
11. 1985	USAEHA Geohydrologic Study	Propellant Burning Ground	10 wells: 4 single wells (PBN-85-01A through PBN-85-04A) and 6 single wells (PBM-85-01 through PBM-85-06)	NA	NA
12. 1985	Foth & Van Dyke Soil Sampling Analysis and Evaluation of Settling Ponds Spoils Sites	Settling Ponds and Spoils Disposal Area	NA	40 samples of dredged settling pond spoils collected from spoils disposal areas	NA
13. 1985	Warzyn Subsurface Investigation at BAAP	Settling Ponds	2 wells consisting of a nested well pair (S-85-1152A,B) <sup>3</sup>	NA	NA
		Existing Landfill	1 well (S-85-1153) <sup>3</sup>	NA	NA

W0039213T 1/2



continued

TABLE 1-1  
SUMMARY OF PREVIOUS FIELD INVESTIGATIONS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

DATE	INVESTIGATIONS	SITES	PROGRAM ELEMENTS		
			MONITORING WELL INSTALLATIONS	SURFACE SOIL SAMPLING	SOIL BORINGS
14 1986	U.S. Army Materiel Command Reactivity Testing Program	Propellant Burning Ground	NA	22 surface soil samples	NA
		Settling Ponds and Spoils Disposal Area	NA	17 surface soil samples	NA
15 1986	USAEHA	Rocket Paste Ditch	NA	6 soil samples	NA
		Rocket Roll Ditch	NA	6 soil samples	
16 1988	U.S. Army Engineer Waterways Experiment Station Geophysical Investigation	Existing Landfill	NA	NA	NA
		Deterrent Burning Ground	NA	NA	NA

Notes:

<sup>1</sup> Wells have since been renumbered as DBN-82-01B and DBN-82-01C.

<sup>2</sup> Wells have since been renumbered as S1147, S1148, S1149, S1150, and S1151.

<sup>3</sup> Wells have since been renumbered as S1152A, S1152B, and S1153.

BAAP - Badger Army Ammunition Plant

NA - not applicable

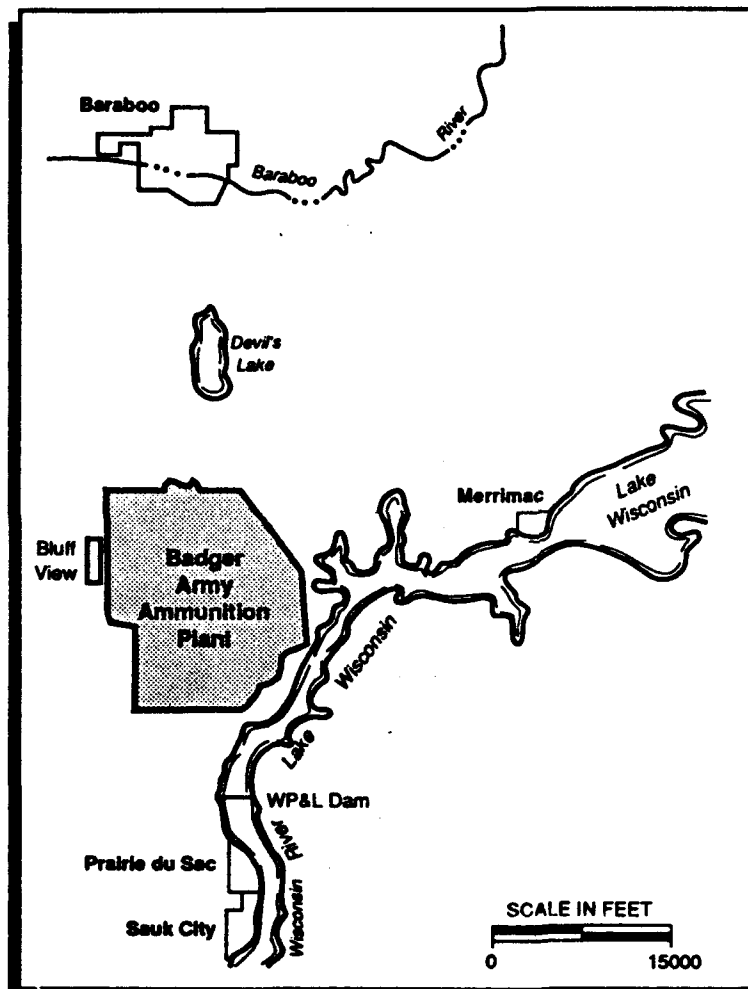
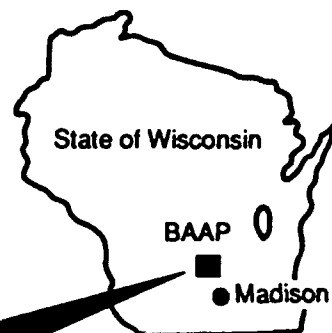
USAEHA - U.S. Army Environmental Hygiene Agency

SARCO - R.F. Sarko & Associates



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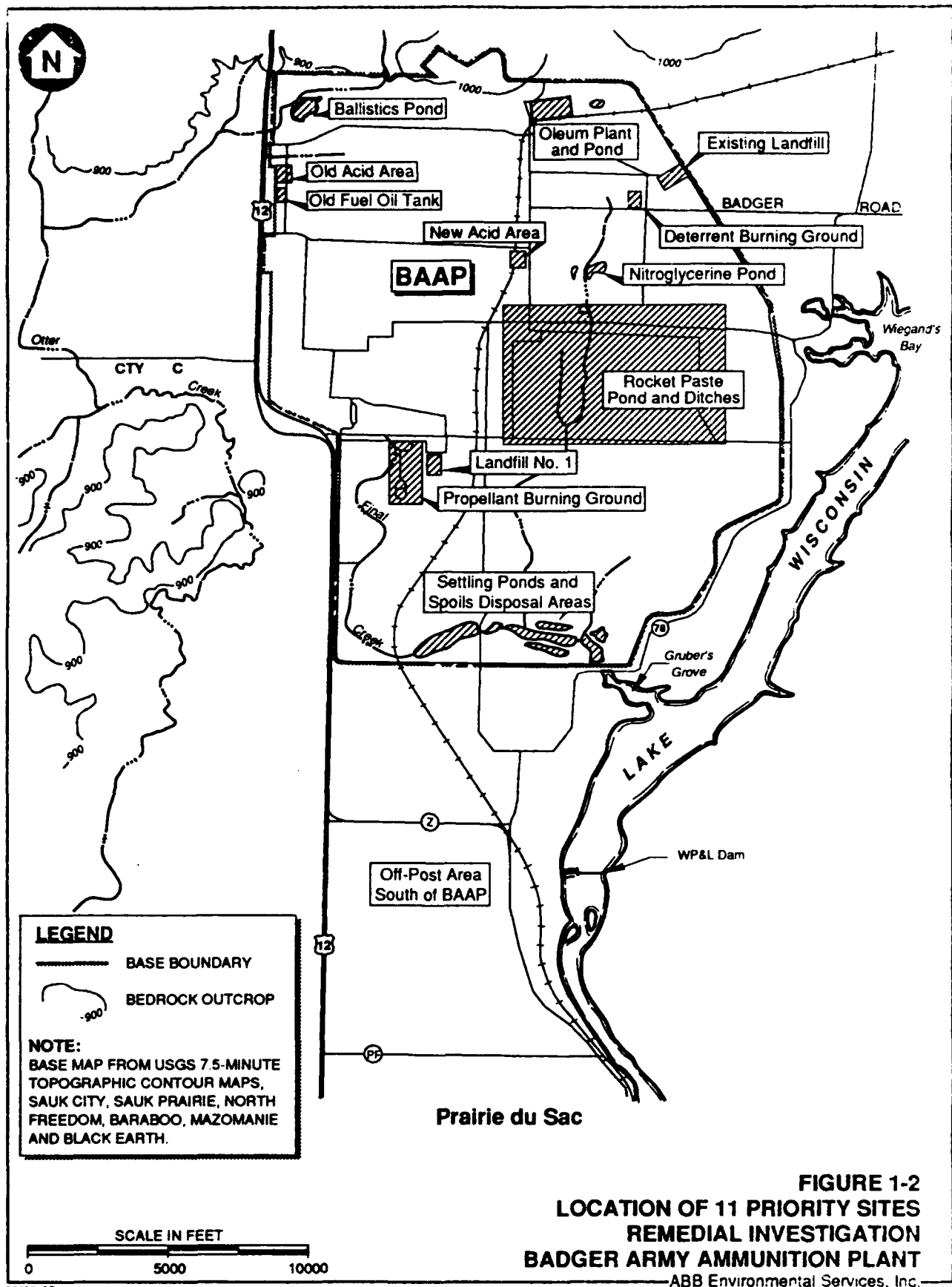


**FIGURE 1-1**  
**SITE LOCATION MAP**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

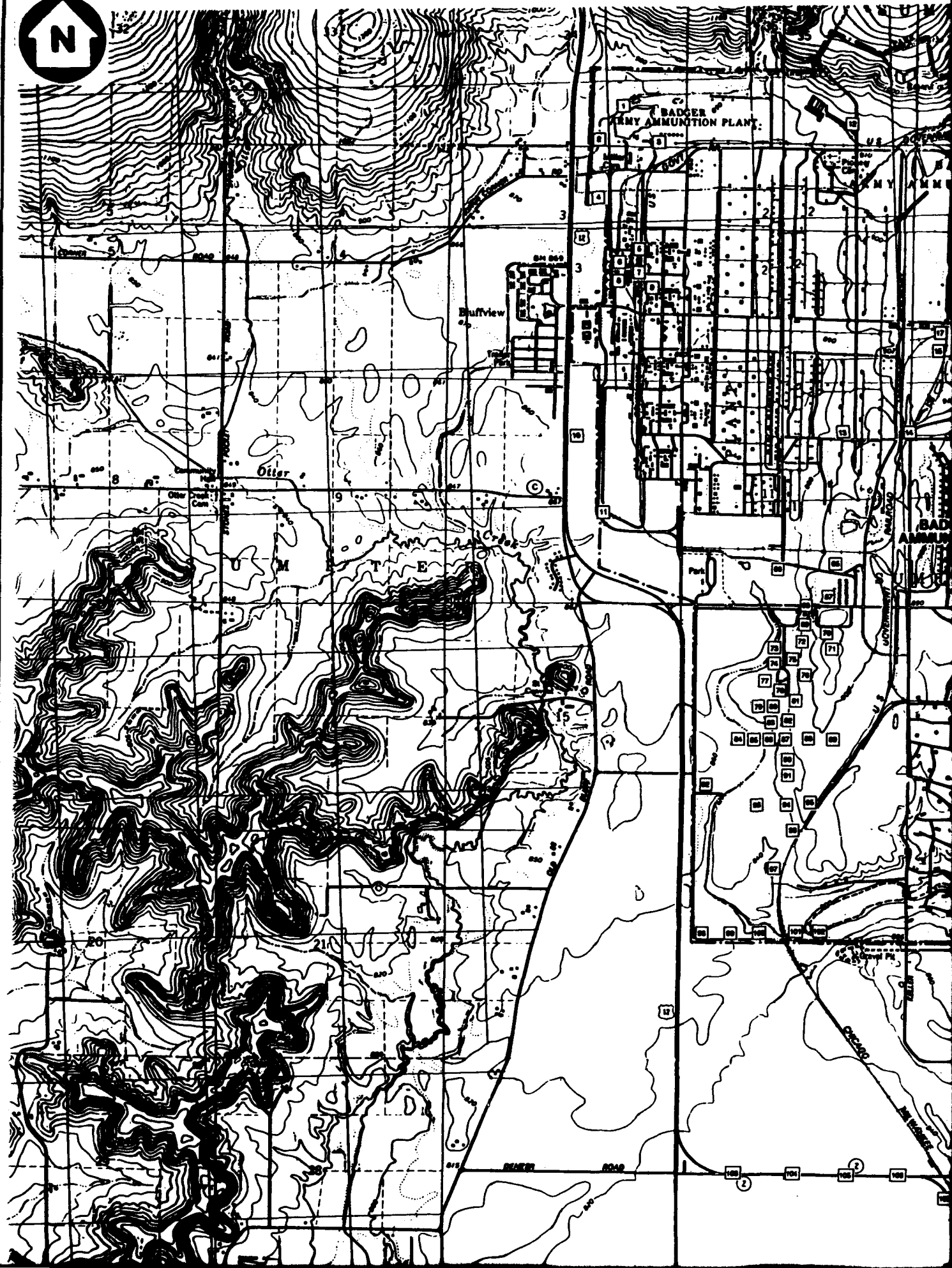
Source: Modified from Tsai, et al., 1988.

ABB Environmental Services, Inc.

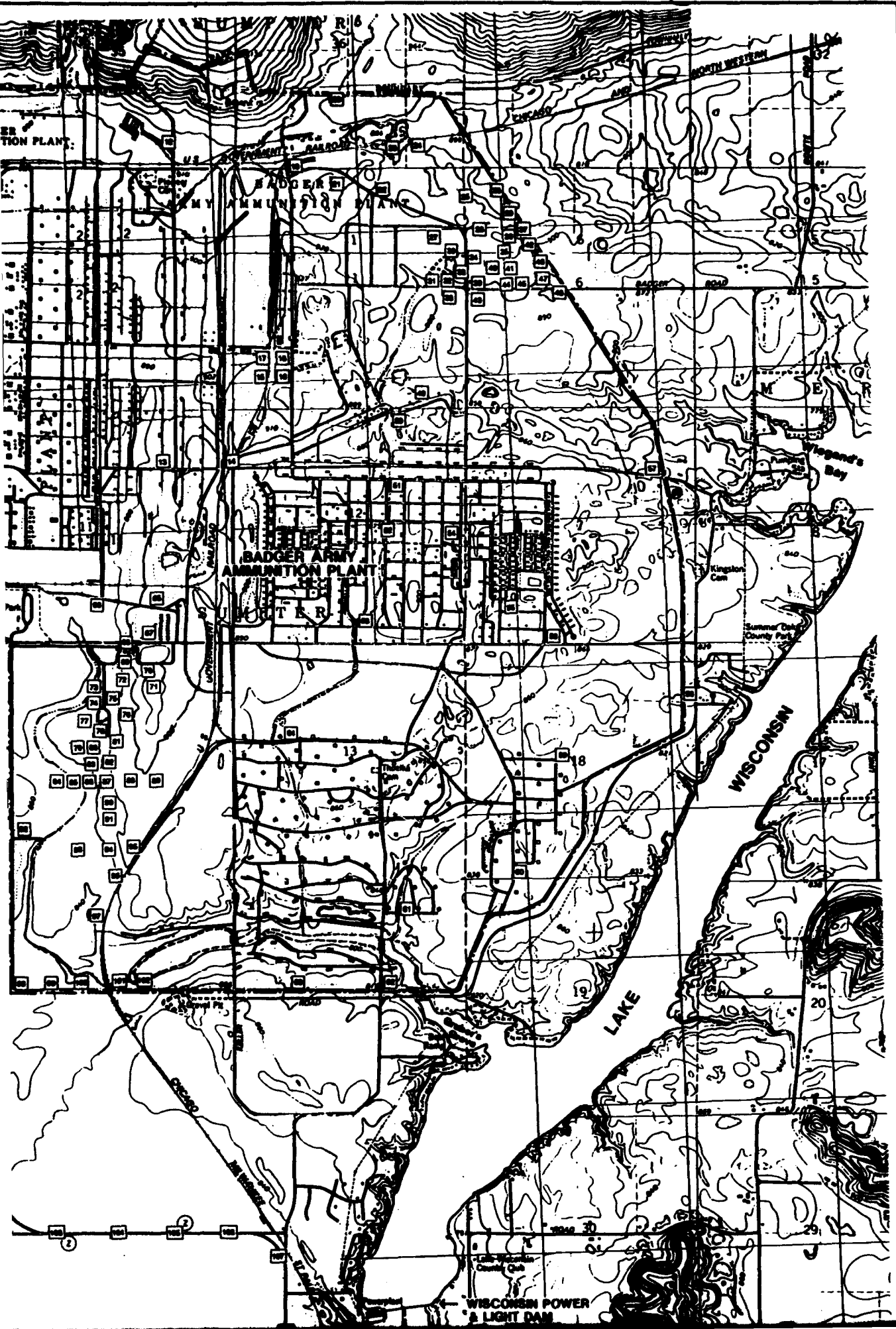




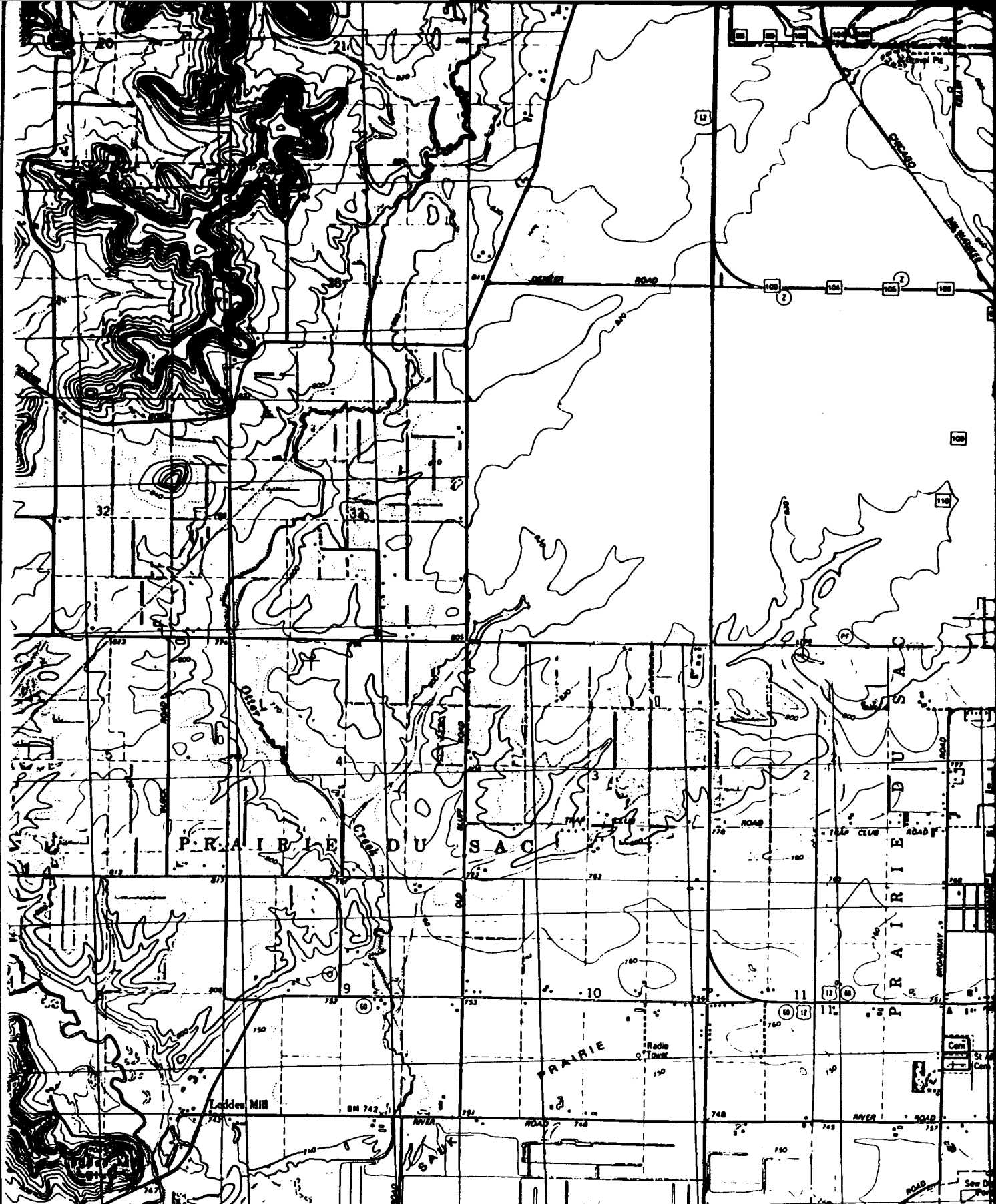












MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.
1	S1129	29	ELN-92-02A,B,C	55	S1120	77	PBM-92-03	97	PBN-99-12A,B
2	BOA-91-01	30	DBM-92-02	56	PRM-91-01	78	PBM-92-04	98	SPN-99-01C
3	S1127	31	DBM-99-05	57	S1121	79	S1146	99	S1133
4	BOA-91-02	32	DBM-92-01B,C	58	S1113	79	PBN-92-03A,B,C	99	S1101
5	OAM-91-01	33	S1122	59	S1114	80	S1117	99	SPN-99-02A,B,C
6	OAM-99-01	34	DBM-92-01	60	S1112	81	PBN-92-05A,B,C	99	SPN-91-02D
7	OAM-99-02	35	ELM-99-09	61	S1111	82	PBN-92-04A,B,C	100	SPN-99-03B,C
8	FTM-99-01	36	S1134	62	S1110	83	PBM-95-01	100	SPN-91-03D
9	S1126	37	ELN-92-03A,B,C	63	S1107	84	PBM-99-05	101	S1148
10	BOA-91-03	38	ELN-99-04A,B	64	S1108	85	PBN-99-03B,C	101	SPN-99-04B,C
11	S1123	39	DBM-99-01	65	SPN-99-05A,B	86	PBN-95-03A	101	SPN-91-04D
12	S1129	40	DBM-99-03	66	S1105	87	PBM-95-02	102	S1152A,B
13	S1125	41	ELM-99-01	67	S1106	88	PBN-99-01B,C,D	102	S1149
14	S1150	42	ELM-99-02A,B	68	S1104	89	PBN-95-01A	102	S1102
15	NAN-91-01A	43	ELM-91-10	69	S1116	90			

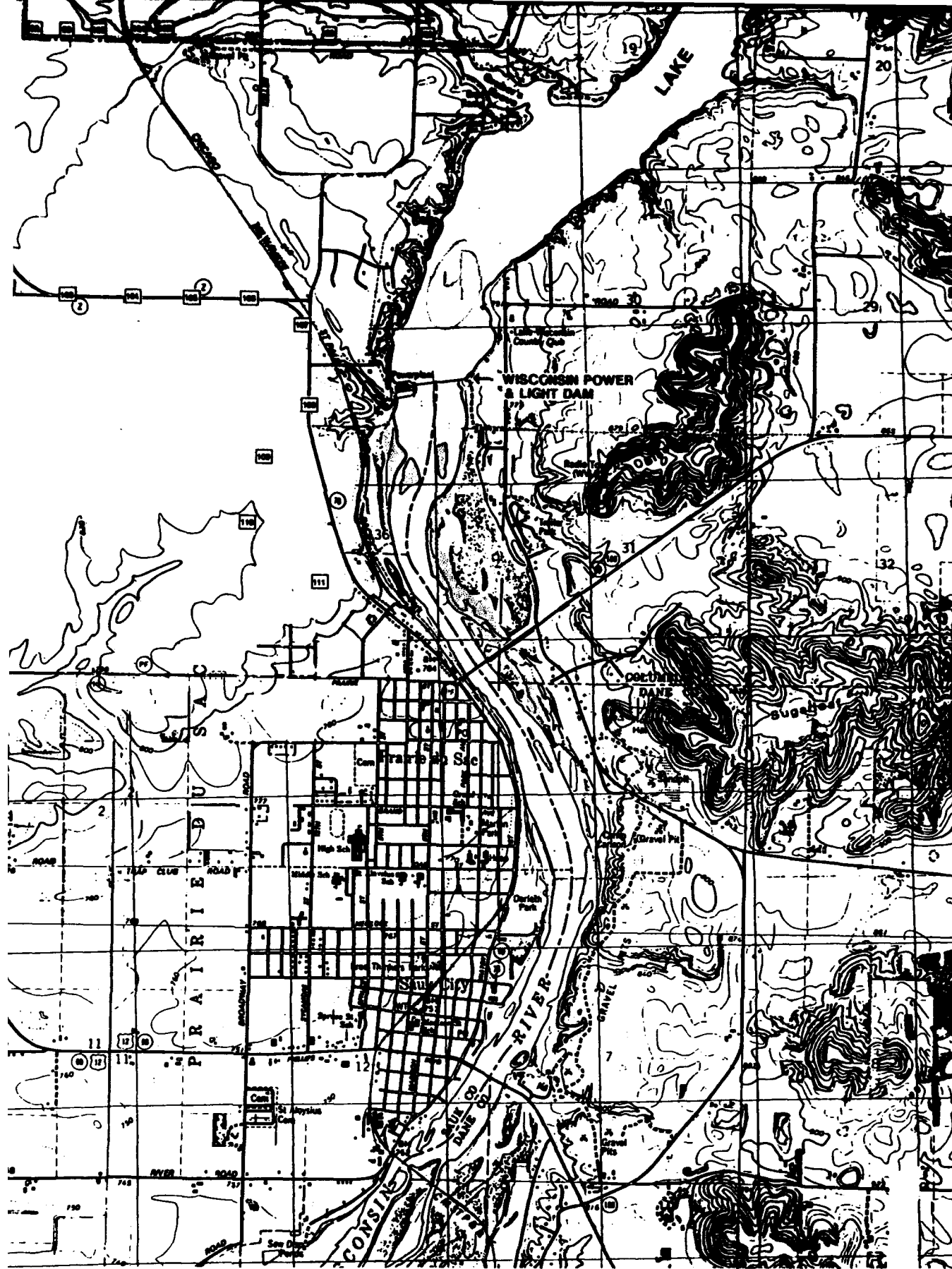
# **LEGEND**

75 MAP CODE DESIGNATIONS TO MONITORING WELL LOC PRESENTED IN LOWER LEFT

## **NOTE:**

1. BASE MAP FROM USGS 7.5-MIN CONTOUR MAPS, SAUK CITY, SA NORTH FREEDOM, BARABOO, M





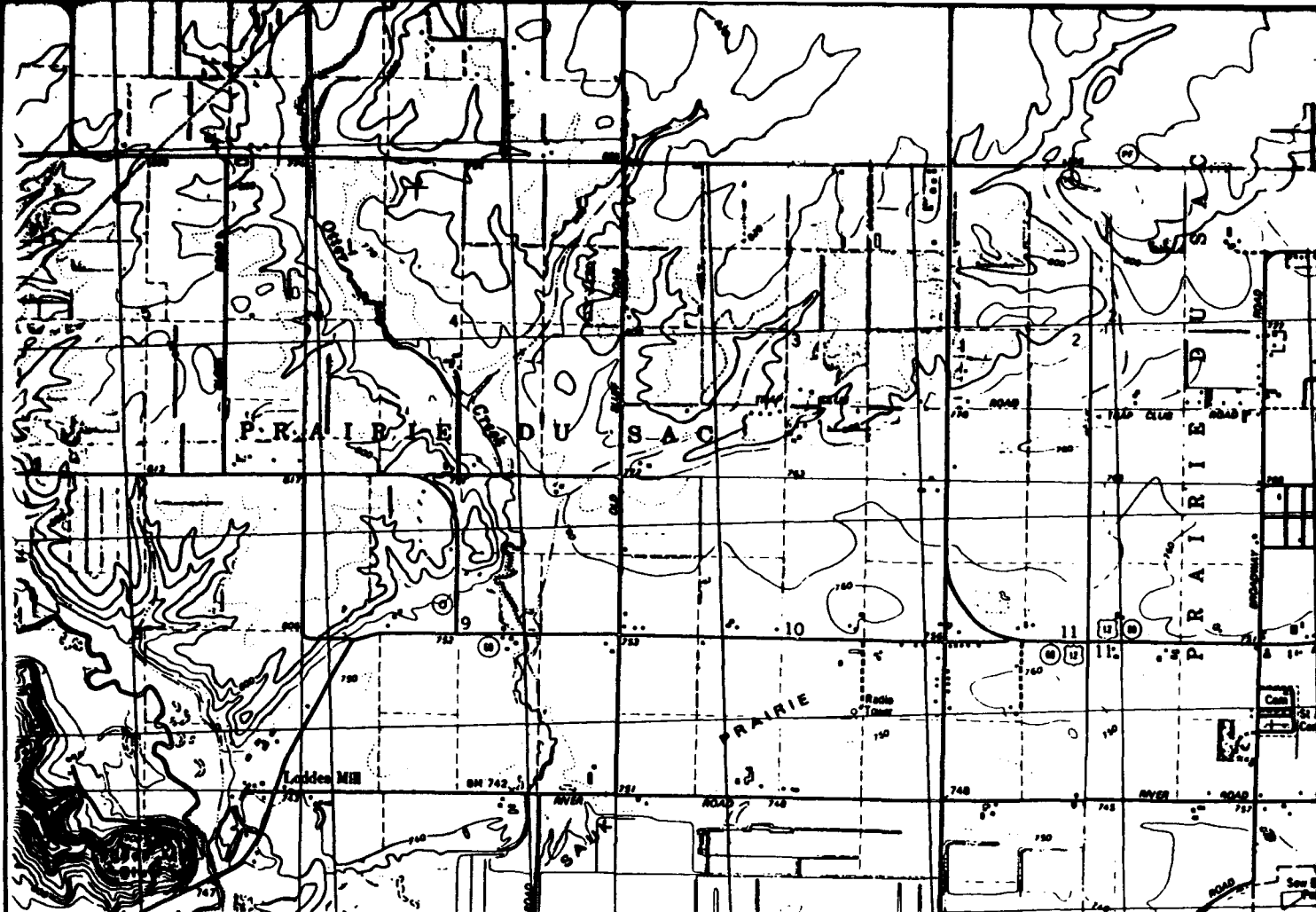
# **LEGEND**

MAP CODE DESIGNATIONS WHICH CORRELATE TO MONITORING WELL LOCATIONS ARE PRESENTED IN LOWER LEFT-HAND CORNER.

## **NOTE:**

1. BASE MAP FROM USGS 7.5-MINUTE TOPOGRAPHIC CONTOUR MAPS, SAUK CITY, SAUK PRAIRIE, NORTH FREEDOM, BARABOO, MAZOMANIE AND BLACK EARTH.





MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.	MAP CODE	WELL NO.
1	S1128	29	ELN-82-02A,B,C	55	S1120	77	PBM-82-03	97	PBN-86-12A,B
2	BGM-91-01	30	DBM-82-02	56	PRM-91-01	78	PBM-82-04	98	SPN-89-01C
3	S1127	31	DBM-89-05	57	S1121	79	S1148	99	S1133
4	BGM-91-02	32	DBN-82-01B,C	58	S1113	79	PBN-82-03A,B,C	99	S1101
5	OAM-91-01	32	S1122	58	S1114	80	S1117	99	SPN-89-02A,B,C
6	OAM-89-01	33	DBM-82-01	59	S1112	81	PBN-82-05A,B,C	99	SPN-91-02D
7	OAM-89-02	34	ELM-89-09	60	S1111	81	PBM-82-05	100	SPN-89-03B,C
8	FTM-89-01	35	S1134	61	S1110	82	PBN-82-04A,B,C	100	S1147
9	S1126	36	ELN-82-03A,B,C	62	S1107	83	PBM-85-01	100	SPN-91-03D
10	BGM-91-03	37	ELN-89-04A,B	62	S1108	84	PBM-89-05	101	S1148
11	S1123	38	DBM-89-01	62	SPN-89-05A,B	85	PBN-89-03B,C	101	SPN-89-04B,C
12	S1129	39	DBM-89-03	63	S1105	85	PBN-85-03A	101	SPN-91-04D
13	S1125	40	ELM-89-01	63	S1108	86	PBN-85-02	102	S1152A,B
14	S1159	41	ELM-89-02A,B	63	S1104	87	PBN-89-01B,C,D	102	S1149
15	NAN-91-01A	42	ELM-91-10	64	S1118	87	PBN-85-01A	102	S1102
16	NAN-91-04B,C	42	S1135	64	S1115	87	PBM-85-03	102	S1103
17	NAN-91-02B	43	DBN-89-02A,B	65	LOM-91-02	88	PBN-89-02B,C	103	SWN-91-01B,C,D
18	NAN-91-03B,C	44	ELM-89-08	66	PBM-89-11	88	PBN-85-02A	104	SWN-91-02C,D
19	OPM-89-01	45	ELM-89-07	67	LOM-91-01	89	PBM-89-08	105	SWN-91-03B,C,D,E
20	S1131	46	S1153	68	PBM-89-09	90	PBM-85-04	106	SWN-91-04C,D
21	S1130	46	ELN-89-08B	68	PBN-89-01A,B,C	91	PBN-85-05	107	SWN-91-05B,C,D
22	OPM-89-03	47	ELM-89-03	70	LOM-89-01	92	S1109	108	PBN-91-01C
23	S1132	48	ELN-91-07A,B	71	LOM-89-03A,B	93	PBM-89-07	108	PBM-89-01D
24	OPM-89-02	49	S1124	71	LOM-89-02A,B	94	PBN-85-04A	109	PBM-89-02D
25	S1151	50	NPM-89-01	72	PBN-82-02A,B,C	94	PBN-89-04B,C	109	PBN-91-02B,C
26	ELN-82-01A,B,C	51	S1119	73	PBM-82-01	95	PBN-89-08	110	PBN-91-03B,C
27	ELM-89-06	52	RPM-89-02	74	S1144	96	PBN-85-06	110	PBM-89-03D
28	DBN-89-04A,B	53	S1118	75	PBN-82-02	96	PBN-91-08C,D	111	PBN-89-04A,D
28	ELN-82-04A,B,C	54	RPM-89-01	76	PBN-89-10A,B,C,D	97	PBN-91-12C,D		

# LEGEND

MAP CODE DESIGNATIONS TO MONITORING WELL LOCATIONS PRESENTED IN LOWER LEFT

## NOTE:

1. BASE MAP FROM USGS 7.5-MIN CONTOUR MAPS, SAUK CITY, NORTH FREEDOM, BARABOO, & BLACK EARTH.

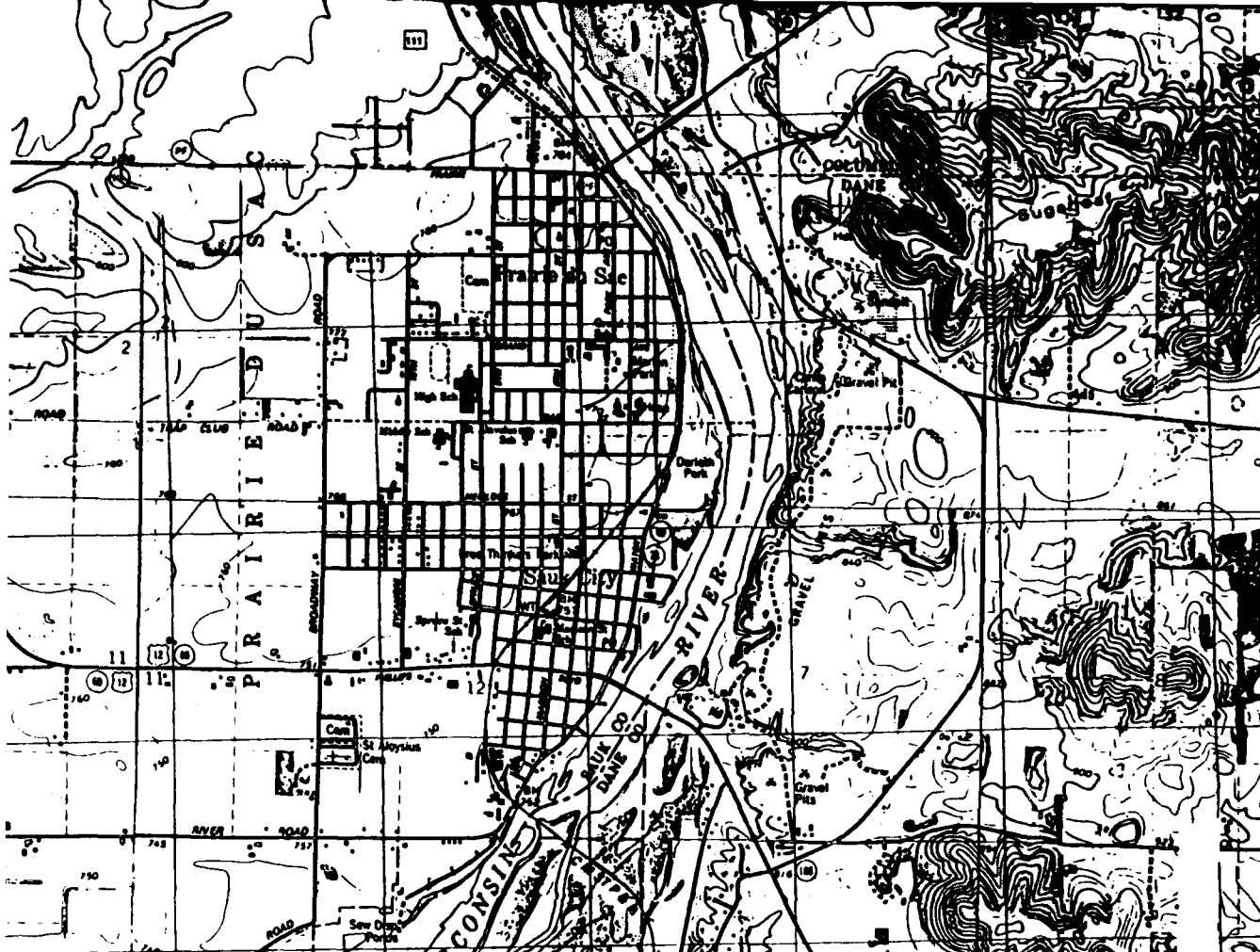
SCALE IN FEET



6853-12/9209072T

5





**FIGURE 1-3**  
**MONITORING WELLS SAMPLED**  
**DURING THE REMEDIAL INVESTIGATION**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



TABLE 2-1  
LOCATION AND CURRENT USE OF BAAP PRODUCTION WELLS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

WELL	LOCATION	USE
PW-1	Approximately 600 feet southeast of administration building 200.	Potable water supply at BAAP; tested quarterly per WDNR regulations; screened in bedrock.
PW-2	Approximately 100 feet north of New Acid Area.	Process water source for BAAP; no current testing; screened in bedrock.
PW-3	Approximately 1,000 feet north of Old Acid Area.	Currently out of service; used for water levels by USGS; screened in bedrock.
PW-4	Approximately 1,200 feet northwest of the Deterrent Burning Ground and approximately 1,600 feet southeast of the Oleum Pond.	Backup to PW-2 for process water; screened in sand and gravel.
PW-5	Approximately 400 feet west of the Propellant Burning Ground.	Not currently used, but still functional; screened in bedrock.



TABLE 2-2  
SUMMARY OF BORINGS/MONITORING WELLS INSTALLED -  
BACKGROUND AREAS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

WELL IDENTIFIER	DILLING METHOD	BORING DEPTH FROM GROUND SURFACE (Ft.)	ELEVATION OF BASE OF SCREEN (Ft. MSL)	LENGTH OF WELL SCREEN (Ft.)	LOCATION	PURPOSE
BGM-91-01	Dual-Wall Driven Casing	78.0	802.5	10	Upgradient and west of Ballistics Pond	To assess background subsurface soil and groundwater quality upgradient of BAAP
BGM-91-02	Dual-Wall Driven Casing	87.0	790.6	10	Upgradient and northwest of Old Acid Area	To assess background subsurface soil and groundwater quality upgradient of BAAP
BGM-91-03	Dual-Wall Driven Casing	100.0	761.6	10	Upgradient and south of Administration Building	To assess background subsurface soil and groundwater quality upgradient of BAAP



TABLE 2-3  
BACKGROUND METALS CONCENTRATIONS IN SURFACE SOIL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

BACKGROUND METAL CONCENTRATION	SAMPLE LOCATION							REGIONAL DATA	
	BSS-90-01	BSS-90-02	BSS-90-03	BSS-90-04	BSS-90-05	Mean	Mean	CONCEN. RANGE	MEAN CONCEN.
AS	8.47	8.44	8.00	4.19	4.81	6.78	6.6	1.9 - 16.0	6.6
AG	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803		0.03 - 2.8	
AL	34300	41100	41100	21500	26100	32820	33000	LT 700 - 50000	33000
BA	208	200	201	220	289	224	675	200 - 1500	675
BE	1.12	1.46	1.52	0.785	1.00	1.18	0.55	LT 1 - 15	0.55
CA	3190	3440	3570	3440	4300	3598	3400	3500 - 5200	3400
CD	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20		0.41 - 0.51	
CO	12.6	11.8	12.1	8.37	12.8	11.5	11	3 - 30	11
CR	37.4	46.8	40.4	23.3	29.8	35.5	55	10 - 100	55
CU	14.2	20.9	18.5	7.46	9.78	14.2	25	7 - 100	25
FE	33700	38100	36700	18800	23200	30100	14000	100 - 30000	14000
HG	LT 0.05	0.063	LT 0.05	0.19	LT 0.05	0.066	0.08	0.01 - 0.38	0.08
K	5260	4070	4330	2690	3670	4004	12000	2200 - 65000	12000
MG	5720	6340	5800	3020	3850	4946	2100	50 - 7000	2100
MN	772	647	647	810	1400	855	525	50 - 1500	525
NA	114	181	195	128	175	158	2500	3000 - 10000	2500
NI	23.5	27.9	24.9	13.9	16.7	21.4	17	5 - 30	17
PB	10.9	10.0	LT 7.44	12.9	15.8	10.7	19	10 - 30	19
SB	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	0.52	0.25 - 0.60	0.52
SE	LT 20.7	LT 20.7	LT 20.7	LT 20.7	LT 20.7	LT 20.7	0.26	0.02 - 0.70	0.26
TL	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3	LT 34.3		0.02 - 2.8	



**TABLE 2-3**  
**BACKGROUND METALS CONCENTRATIONS IN SURFACE SOIL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

BACKGROUND METAL CONCENTRATION	SAMPLE LOCATION					REGIONAL DATA	
	BSS-90-01	BSS-90-02	BSS-90-03	BSS-90-04	BSS-90-05	Mean Concen.	CONCEN. RANGE
V	75.8	90.0	91.3	45.7	56.7	71.9	LT 7 - 100
ZN	79.4	71.9	60.3	52.9	81.3	69.2	28 - 45
							43
							40

**Notes:**

1. All concentrations are in UG/G, equivalent to parts per million
2. Samples are located on Figure 2-6 and were collected on September 5 to 6, 1990.
3. Regional data based upon Shacklette & Boeringen, 1984 and Kabata-Pendias & Pendias, 1984.
4. Laboratory data summarized in Appendix K.
5. LT (less than) indicates the analyte was not detected above the certified reporting limit.
6. If an LT value was present in a range of concentrations for an analyte, the mean concentration for the analyte was calculated using one-half the LT value (or Certified Reporting Limit).



TABLE 2-4  
BACKGROUND ANALYTE CONCENTRATIONS IN SUBSURFACE SOIL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

BACKGROUND ANALYTE CONCENTRATION	BGM-91-01			BGM-91-02			BGM-91-03			CONCEN. RANGE	MEAN CONCEN.
	20-22'	40-42'	60-62'	20-22'	40-42'	60-62'	20-22'	40-42'	60-62'		
AS	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.5
AG	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803	LT 0.803
AL	2060	1230	1550	923	1400	1290	2320	1330	2280	923-2320	1598
BA	7.80	3.99	4.33	LT 3.29	4.27	3.67	5.58	3.67	5.84	LT 3.29-7.8	4.53
BE	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427	LT 0.427
CA	60000	13900	20600	12200	17300	22300	26200	21400	19800	13900-60000	23678
CD	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20	LT 1.20
CO	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50	LT 2.50
CR	3.81	3.36	3.83	1.89	3.63	2.60	10.4	4.47	3.04	1.89-10.4	4.11
CU	16.9	15.2	10.5	5.79	LT 2.84	4.77	27.5	13.1	8.48	2.84-27.5	11.52
FE	5620	3060	5650	1820	2890	3060	5080	2810	2430	1620-5650	3580
HG	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
K	375	225	284	169	314	178	270	267	302	178-375	265
MG	31900	7450	11000	5950	8780	11100	13000	10600	9660	5950-31900	12160
MN	383	68.7	87.7	48.6	82.7	77.9	119	79.4	106	48.6-383	117
NA	213	144	154	93.8	140	156	154	124	236	93.8-236	157
NI	4.22	LT 2.74	LT 2.74	LT 2.74	LT 2.74	2.82	6.19	3.90	LT 2.74	LT 2.74-6.19	2.86
PB	3.97	1.09	1.11	0.894	1.18	0.612	1.79	1.04	0.915	0.612-3.97	1.40
SB	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6	LT 19.6
SE	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449	LT 0.449
TL	LT 0.5	LT 0.5	LT 20	LT 0.5	LT 0.5	LT 20	LT 0.5	LT 0.5	LT 0.5	LT 0.5-LT 20	LT 4.83
V	230	15.0	19.0	13.0	11.0	22.0	14.0	20.0	8.60	8.6-23	16.0



continued

TABLE 2-4  
BACKGROUND ANALYTE CONCENTRATIONS IN SUBSURFACE SOIL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

BACKGROUND ANALYTE CONCENTRATION	BGM-91-01			BGM-91-02			BGM-91-03			CONCEN. RANGE	MEAN CONCEN.
	20-22'	40-42'	60-82'	20-22'	40-42'	60-82'	20-22'	40-42'	60-82'		
ZN	10.7	9.52	9.31	3.62	4.06	3.36	19.3	7.76	4.75	3.36-19.3	8.04
TCPLP METALS (µg/l)											
CD	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78	LT 6.78
CR	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8	LT 16.8
HG	0.103	LT 0.1	LT 0.1	LT 0.1	LT 0.1	LT 0.1	LT 0.1	LT 0.1	LT 0.1	LT 0.1-0.103	0.056
PB	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4	LT 43.4
Anions											
NIT	LT 1.0	1.18	1.69	2.47	3.42	2.83	3.47	4.07	3.87	LT 1.0-4.07	2.61
SO4	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0	LT 5.0
pH	9.19	10.2	8.77	9.08	9.63	9.89	9.31	9.36	9.35	8.77-10.2	9.42

Notes:

1. Concentrations are in µg/g, equivalent to parts per million
2. Samples are located on Figure 2-6 and were collected in October and November 1991.
3. Regional data based upon Shacklette & Boeringer, 1984 and Kabata-Pendias & Pendias, 1984.
4. Laboratory data summarized in Appendix K.
5. LT (less than) indicates the analyte was not detected above the certified reporting limit.
6. If an LT value was present in a range of concentrations for an analyte, the mean concentration for the analyte was calculated using one-half the LT value (or Certified Reporting Limit).



**TABLE 2-5**  
**TCLP METALS DATA SUMMARY FOR SUBSURFACE SOIL -**  
**BACKGROUND BORINGS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SAMPLE LOCATION	DEPTH	TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )				NOTES
		CD	CR	PB	HG	
TCLP RL <sup>1</sup>		1,000	5,000	5,000	200	
Minimum Reporting Value		6.8	16.8	43.4	0.1	
BGM-91-01	22	LT	LT	LT	0.1	TCLP RL not exceeded
BGM-91-01	42	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-01	62	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-02	22	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-02	42	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-02	62	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-03	22	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-03	42	LT	LT	LT	LT	TCLP RL not exceeded
BGM-91-03	62	LT	LT	LT	LT	TCLP RL not exceeded

**Notes:**

- <sup>1</sup> TCLP Regulatory Level (RLs) exist for the following metals: AS, BA, CD, CR, SE, PB, HG, and AG. However, samples were only analyzed for CD, CR, PB, and HG. (See List of USATHAMA Chemical Codes for definitions of chemical abbreviations).
- <sup>2</sup> LT - Less than the Certified Reporting Limit; corrected for percent moisture, dilution, and percent recovery.
- <sup>3</sup> Sample locations shown on Figure 2-6.



TABLE 2-6  
SUMMARY OF AVERAGE BACKGROUND GROUNDWATER QUALITY DATA -  
BACKGROUND AREAS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	BGM-91-01	BGM-91-02	BGM-91-03	S1123
Sample Type:	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/06/91	12/07/91	12/07/91	12/05/91
ROUND:	ONE	ONE	ONE	ONE
	04/09/92	04/09/92	04/14/92	04/14/92
	TWO	TWO	TWO	TWO
VOCs				
CH2CL2	3.82	7.06	6.37	5.2
CHCL3	P	P	B	P
TCLEE	-	-	0.624	P
B2EHP	-	-	0.386	P
SVOCS	-	-	57.3	-
Metals				
AG	-	-	-	-
AL	-	-	-	-
AS	-	-	-	-
BA	24.7	27.5	30.5	25.3
BE	-	26.6	-	-
CA	61000	50000	74000	77000
CD	-	-	-	-
CR	7.31	6.56	8.24	6.72
CU	-	-	-	-
FE	56.3	266	46.4	18
HG	-	-	-	40.8
K	1160	1280	855	1150
MG	32000	29000	34000	39000
MN	-	-	-	-
NA	-	-	-	-
NI	-	-	-	-
PB	-	-	-	-
SB	-	-	-	-
SE	-	-	-	-
V	-	-	-	-
ZN	-	-	-	-
Anions				
NIT	2700	2800	10000	9100
CL	4800	27000	13000	27000
SO4	18000	16000	27000	16000
Indicator				
ALK	232000	188000	210000	252000
HARD	252000	170000	312000	246000
TDS	257000	243000	296000	295000
pH(1)	8.2	8.2	8.4	7.9
Sp.Cond.(2)	539	522	605	570
				563

Notes and flagging codes are presented at the end of this table.



TABLE 2-6  
SUMMARY OF AVERAGE BACKGROUND GROUNDWATER QUALITY DATA -  
BACKGROUND AREAS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1129	S1130	S1131									
Sample Type:	WELL	WELL	WELL									
UNITS:	UGL	UGL	UGL									
DATE SAMPLED:	12/04/91	11/24/91	04/08/92	04/08/92								
ROUND:	ONE	ONE	TWO	TWO								
	ONE	ONE	TWO	TWO								
VOCs	CH2CL2 CHCL3 TCLEE	5.1 - -	P - -	B - -	6.96 - -	B - -	4.71 - -	P - -	6.86 - -	P - -	N/A N/A N/A	CONCENTRATION RANGE
SVOCs	B2EIP	-	-	-	-	-	33.4	P	-	-	N/A	
Metals	AG	-	-	-	-	-	-	-	-	-	N/A	
	AL	-	-	-	-	-	-	-	-	-	N/A	
	AS	-	-	-	-	-	-	-	-	-	N/A	
	BA	35.4	-	27.9	-	32.5	-	22.2	-	27	N/A	14.6-36.2
	BE	-	-	-	-	-	-	-	-	-	N/A	
	CA	64000	-	26000	-	31000	-	24000	-	52000	N/A	24000-77000
	CD	-	-	-	-	-	-	-	-	-	N/A	
	CR	11.6	-	-	-	4.79	-	7.22	-	4.5	N/A	CRL-11.6
	CU	-	-	-	-	-	-	64.2	-	3.6	N/A	CRL-18
	FE	108	-	47.6	-	29.1	-	-	-	56	N/A	CRL-266
	HG	-	-	-	-	-	-	-	-	0.59	N/A	CRL-3.93
	K	702	-	456	-	693	-	900	-	1040	N/A	456-1680
	MG	34000	-	16000	-	19000	-	13000	-	27000	N/A	16000-39000
	MN	-	-	-	-	-	-	-	-	-	N/A	
	NA	22000	-	2030	-	2320	-	2550	-	11610	N/A	9900-25000
	NI	-	-	-	-	-	-	-	-	5.4	N/A	CRL-18.1
	PB	-	-	-	-	-	-	69	-	24	N/A	CRL-69
	SB	-	-	-	-	-	-	-	-	N/A	N/A	
	SE	-	-	-	-	-	-	-	-	7.6	N/A	
	V	-	-	-	-	4.88	-	-	-	24	N/A	CRL-11.3
	ZN	-	-	89	-	46.8	-	91.9	-	24	N/A	CRL-91.9
Anions	NIT	370	-	220	-	350	-	740	-	3300	N/A	75.4-10000
	CL	54000	-	46000	-	3600	-	6400	-	18000	N/A	3600-54000
	SO4	41000	-	38000	-	18000	-	6500	-	20000	N/A	6200-41000
Indicator parameter	ALK	232000	-	234000	-	125000	-	92000	-	205000	N/A	92000-303000
	HARD	310000	-	290000	-	140000	-	122000	-	230000	N/A	120000-312000
	TDS	401000	-	339000	-	209000	-	148000	-	258000	N/A	148000-401000
	pH(1)	7.7	-	7.7	-	6.5	-	7.0	-	7.3	N/A	5.2-8.4
	Sp Cond.(2)	611	-	560	-	390	-	256	-	453	N/A	244-611

Notes and flagging codes are presented at the end of this table.



TABLE 2-6  
SUMMARY OF AVERAGE BACKGROUND GROUNDWATER QUALITY DATA-  
BACKGROUND AREAS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
(3)	-	Average concentrations are calculated for all analytes with one or more detected values. For analytes not detected above the CRL, averages are calculated assuming a concentration of one-half the CRL.
UCL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
.	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits
N/A	-	Not Applicable

The CRL average concentrations were not calculated for analytes not detected above CRL or analytes outside certified range.

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RI Report Glossary.



TABLE 2-7  
BACKGROUND SEDIMENT CONCENTRATIONS - REGIONAL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICAL	CRYSTAL LAKE	DELAVAN LAKE	DEVIL'S LAKE	LOST LAKE	LAKE MONONA	CONCENTRATION RANGE	MEAN CONCENTRATION
AL	11400.0 9600.0	2200.0 16800.0 11600.0	27300.0 26900.0	11000.0 15200.0 14900.0	3800.0 16200.0 11600.0	2200.0 - 27300.0	13730.8
CD	3.0 2.4	0.6 2.3 1.6	6.3 7.8	1.8 4.4 6.0	0.5 4.1 2.9	0.5 - 7.8	3.4
CA	84200.0 70900.0	274700.0 175500.0 208100.0	5600.0 5900.0	2900.0 5600.0 5000.0	14400.0 150300.0 160200.0	2900.0 - 274700.0	99453.8
CR	18.0 15.0	2.0 16.0 13.0	35.0 34.0	14.0 22.0 21.0	31.0 159.0 99.0	2.0 - 159.0	36.8
CO	4.0 0.1	0.9 2.8 2.4	7.8 6.8	2.2 4.1 3.4	2.8 5.2 3.6	0.1 - 7.8	3.5
CU	142.0 106.0	12.0 44.0 34.0	36.0 40.0	9.0 25.0 28.0	29.0 184.0 106.0	9.0 - 184.0	61.2
FE	12100.0 10400.0	3200.0 12700.0 11100.0	29700.0 39200.0	11200.0 9200.0 8600.0	5800.0 16800.0 13200.0	3200.0 - 39200.0	14092.3
PB	201.0 172.0	3.0 18.0 11.0	75.0 70.0	65.0 103.0 107.0	39.0 86.0 72.0	3.0 - 201.0	78.6
MG	27900.0 28100.0	11900.0 11000.0 12000.0	4500.0 4300.0	2000.0 2600.0 2600.0	33700.0 17400.0 15500.0	2000.0 - 33700.0	13346.2
MN	280.0 200.0	280.0 690.0	1270.0 560.0	140.0 110.0	440.0 800.0	90.0 - 1270.0	496.9



TABLE 2-7  
BACKGROUND SEDIMENT CONCENTRATIONS - REGIONAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICAL	CRYSTAL LAKE	DELAVAN LAKE	DEVIL'S LAKE	LOST LAKE	LAKE MONONA	CONCENTRATION RANGE	MEAN CONCENTRATION
NI	8.0	540.0	37.0	90.0	1060.0	1.0 - 37.0	12.7
	7.0	1.0	30.0	8.0	4.0		
		8.0		14.0	14.0		
NA		7.0		14.0	13.0	<300.0 - 500.0	223.1
	500.0	400.0	<300.0	<300.0	<300.0		
	500.0	<300.0	<300.0	<300.0	<300.0		

## NOTES

1. All concentrations are in ug/g. equivalent to parts per million.
2. Blank Space indicates a sample was not taken.
3. Source: WDNR 1989, Technical Bulletin 163 "Mercury Levels in Walleyes from Wisconsin Lakes of Different Water and Sediment Characteristics."



continued

**TABLE 2-8**  
**BACKGROUND SEDIMENT CONCENTRATIONS - CONTROL POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

TOTAL METALS AND INORGANICS	SAMPLE		
	CP-1	CP-2	CP-3
PB (Lead)	7.3	12	25
NIT (Nitrogen-Nitrate)	1.0	0.11	0.12
NH3N2 (Ammonia-Nitrogen)	53	230	320
BOD (Biochemical Oxygen Demand)	<15	180	170
COD (Chemical Oxygen Demand)	<1000	23,000	25,000
pH	7.38	7.17	7.70
SO4 (Sulfate)	<20	<20	<20
TOTAL SOLIDS	93%	79%	65%

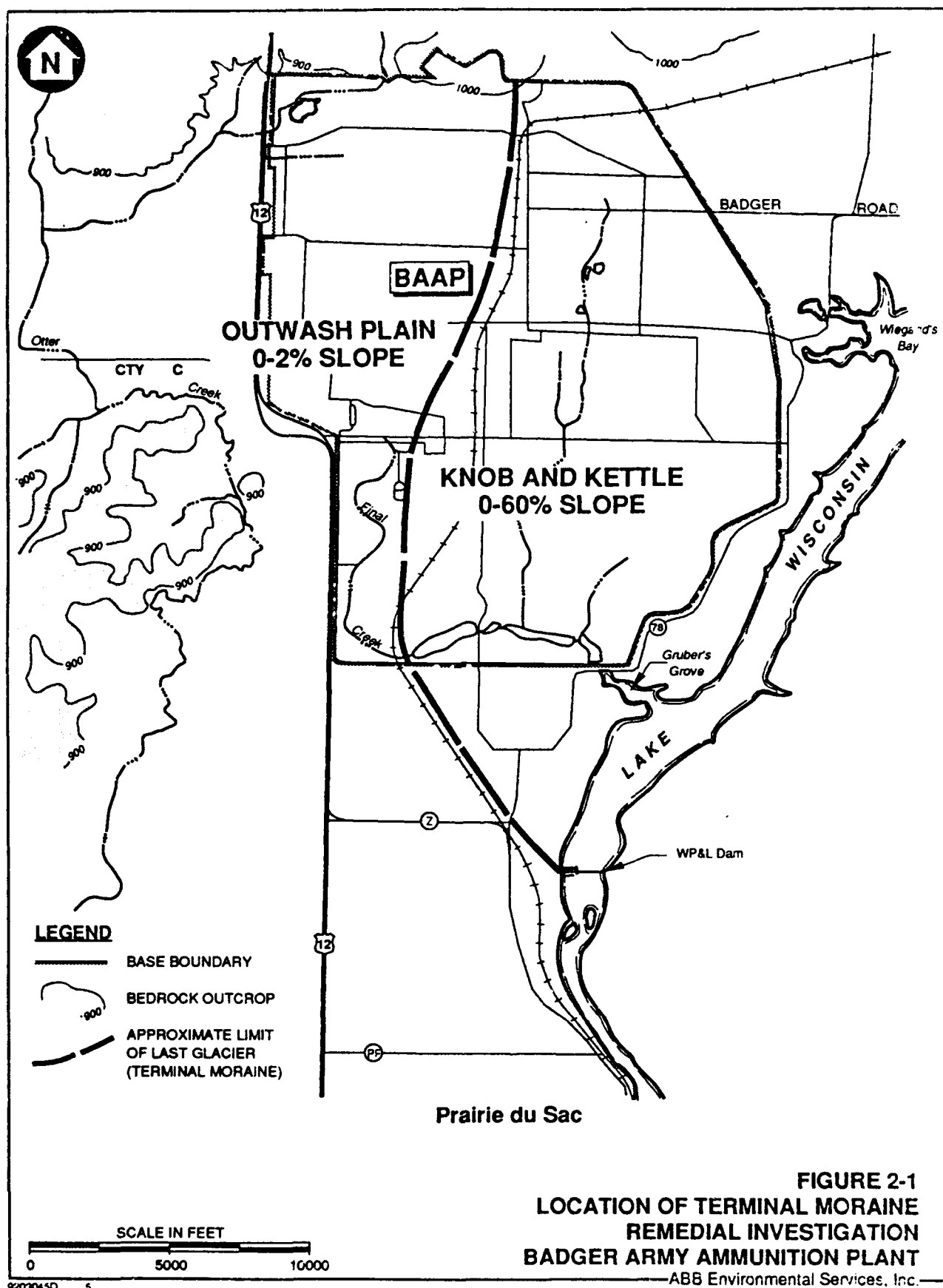
**Notes:**

- (1) Source: Ayres, 1984
- (2) All results are dry weight basis and are listed in  $\mu\text{g/g}$ .

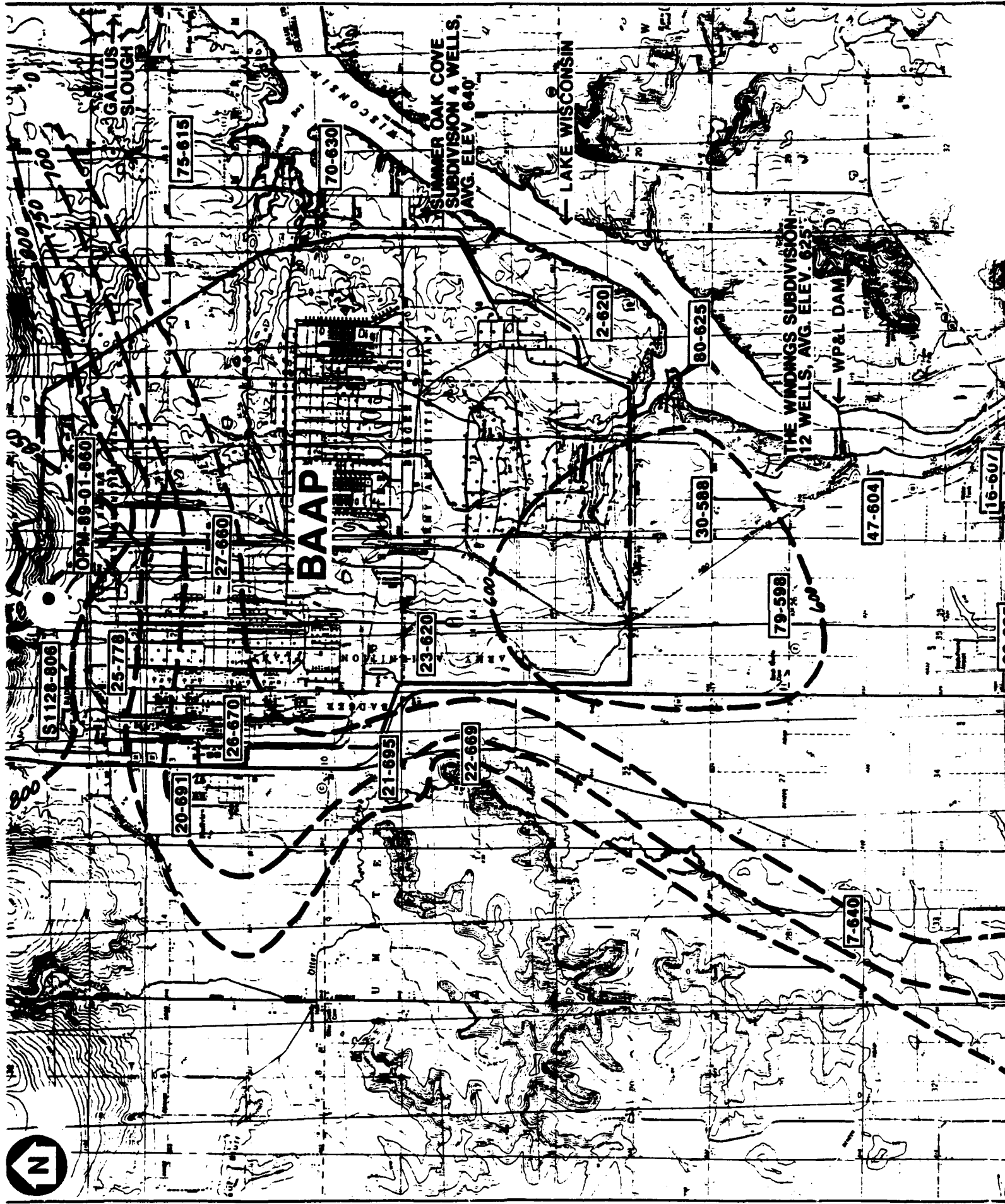


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S1128-806  
OPM-89-01-860  
25-778  
20-691  
26-670  
21-695  
22-669  
23-620  
26-620  
2-620  
80-625  
30-588  
79-598  
47-604  
16-607  
7-640  
75-615  
70-630

BAAP  
ARMY AND NAVY SYSTEM

SUMMER OAK COVE  
SUBDIVISION 4 WELLS,  
AVG. ELEV. 640

LAKE WISCONSIN

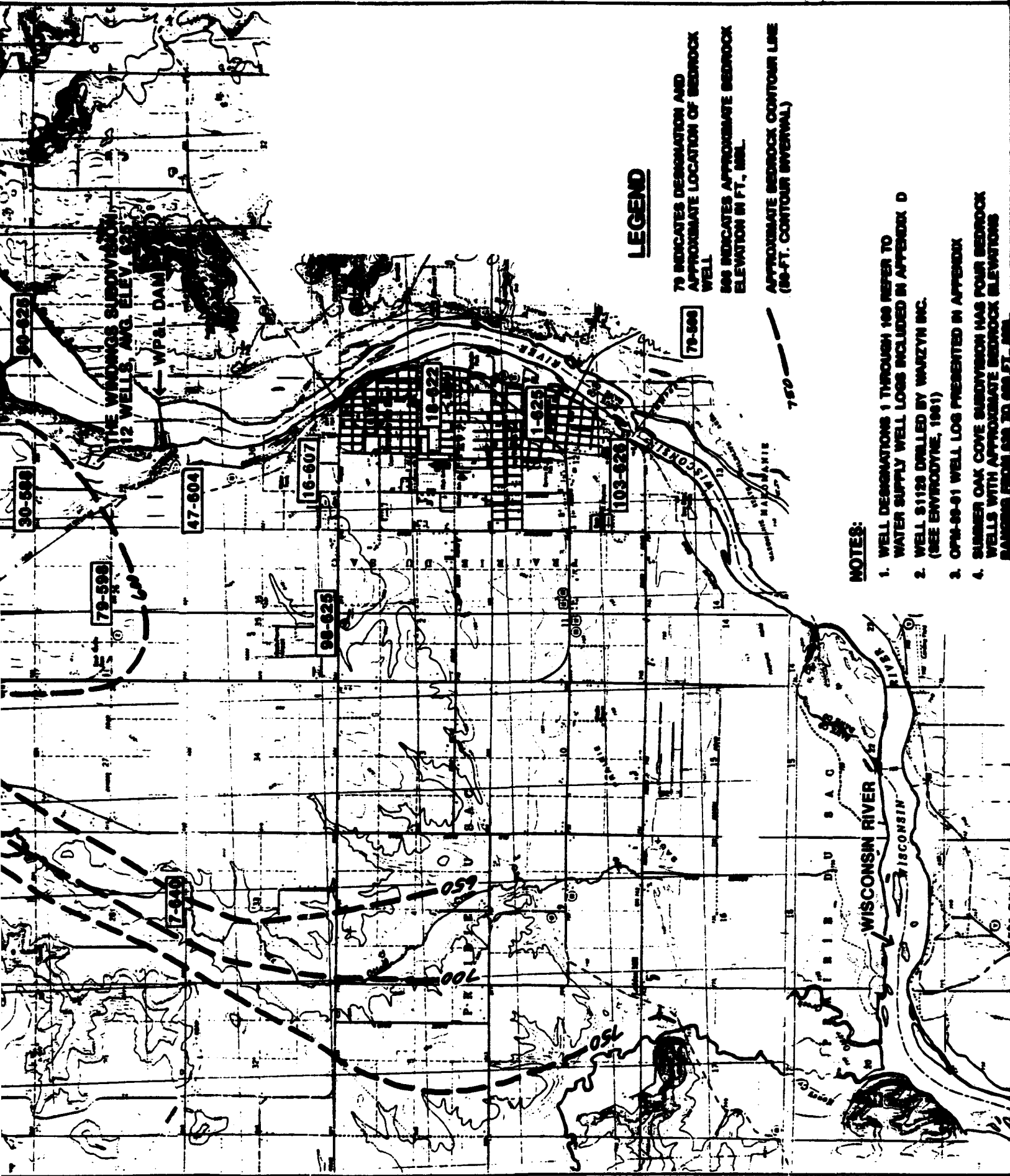
THE WINDINGS SUBDIVISION  
12 WELLS, AVG. ELEV. 625

WP&L DAM

GALLUS SLOUGH

N





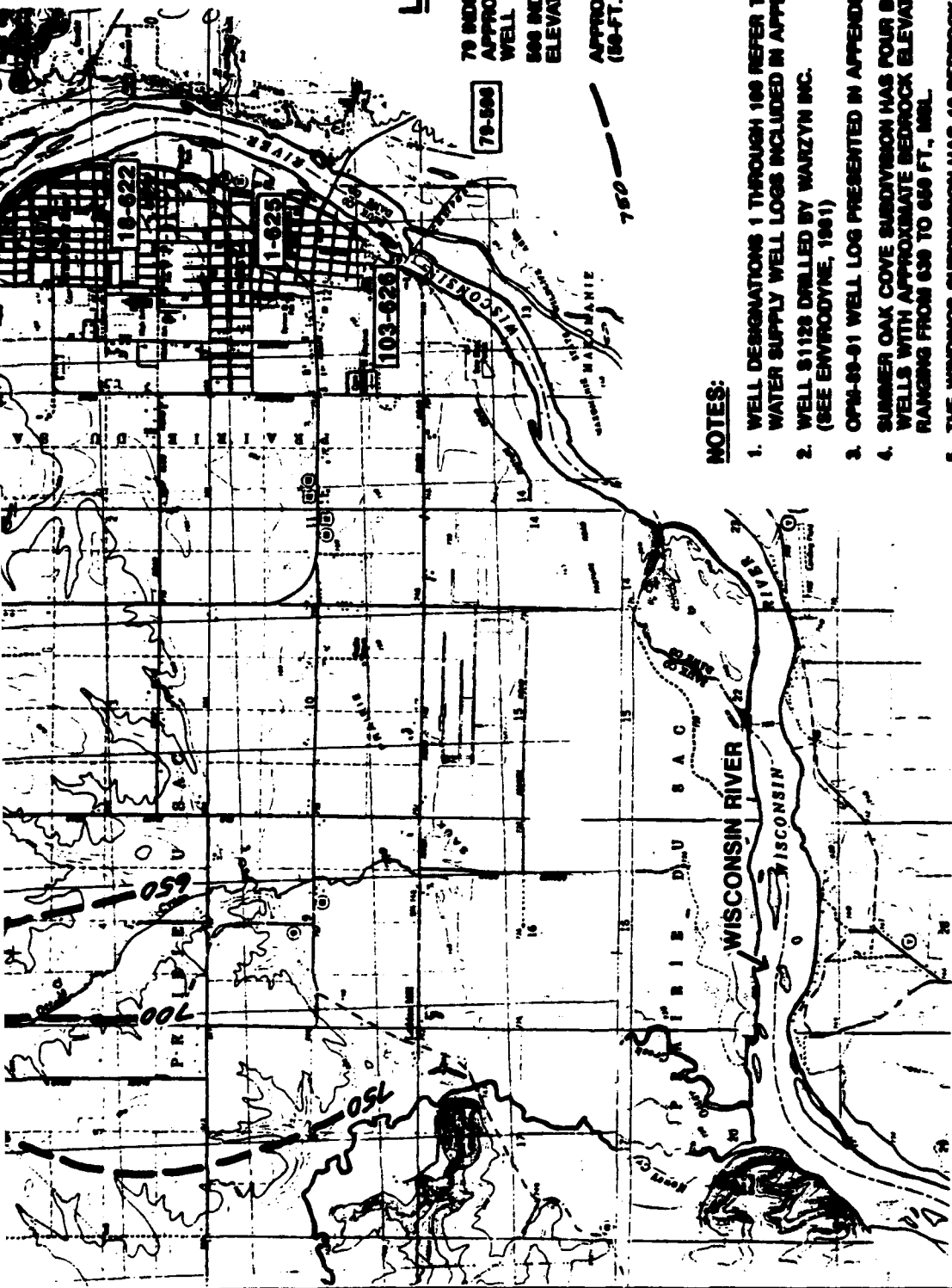
# **LEGEND**

- 79 INDICATES DESIGNATION AND APPROXIMATE LOCATION OF BEDROCK WELL
- 600 INDICATES APPROXIMATE BEDROCK ELEVATION IN FT., MIN.
- APPROXIMATE BEDROCK CONTOUR LINE (80-FT. CONTOUR INTERVAL)

## **NOTES:**

1. WELL DESIGNATIONS 1 THROUGH 100 REFER TO WATER SUPPLY WELL LOGS INCLUDED IN APPENDIX D
2. WELL S1128 DRILLED BY WARZYN INC. (SEE ENVIRONMENTAL, 1981)
3. OPM-88-01 WELL LOG PRESENTED IN APPENDIX
4. SUMNER OAK COVE SUBDIVISION HAS FOUR BEDROCK WELLS WITH APPROXIMATE BEDROCK ELEVATIONS RANGING FROM 630 TO 680 FT., MIN.





# **LEGEND**

- 79 INDICATES DESIGNATION AND APPROXIMATE LOCATION OF BEDROCK WELL
- 500 INDICATES APPROXIMATE BEDROCK ELEVATION IN FT., MSL
- APPROXIMATE BEDROCK CONTOUR LINE (50-FT. CONTOUR INTERVAL)

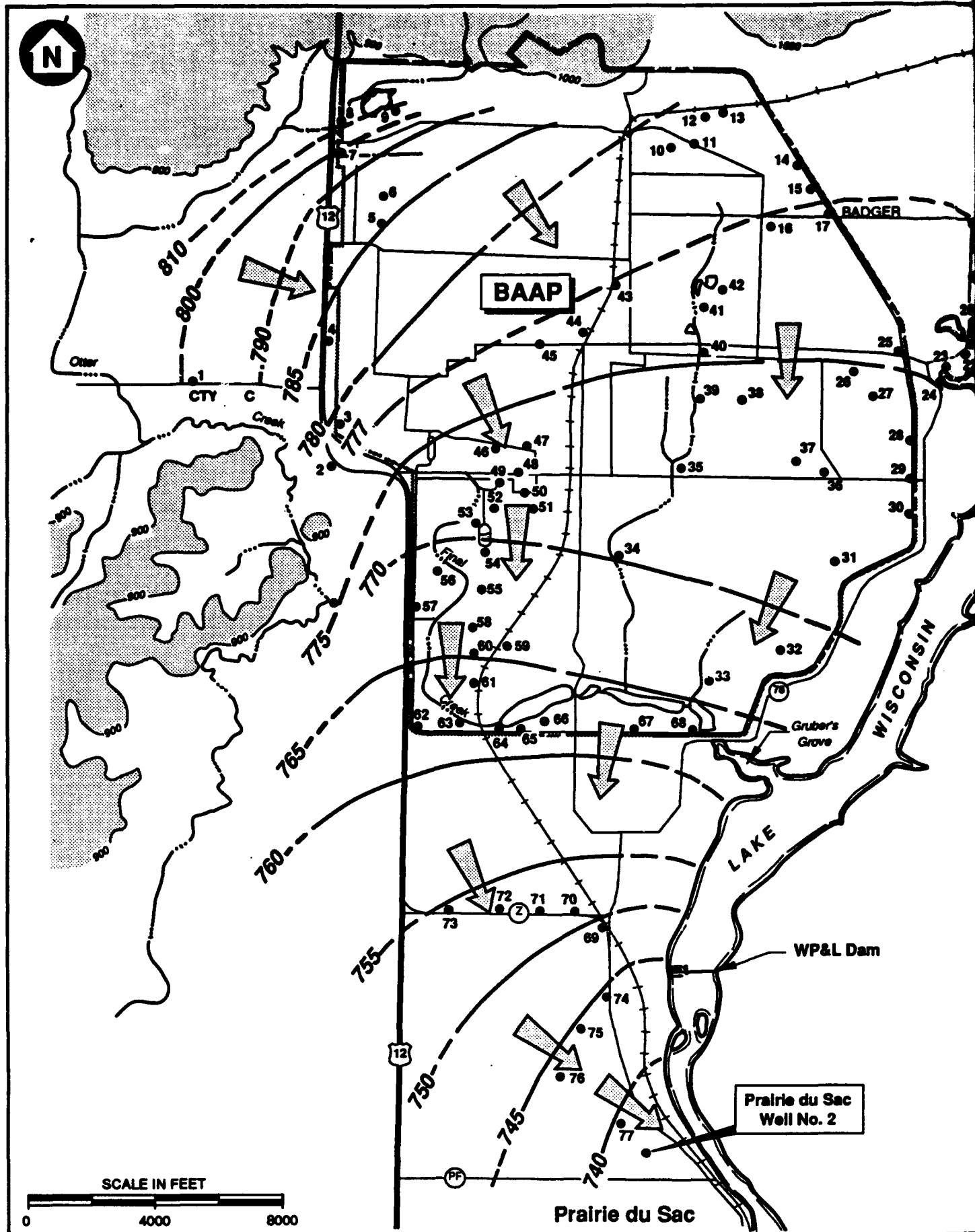
## **NOTES:**

1. WELL DESIGNATIONS 1 THROUGH 100 REFER TO WATER SUPPLY WELL LOGS INCLUDED IN APPENDIX D
2. WELL S1128 DRILLED BY WATZYN INC. (SEE ENVIRODYNE, 1981)
3. OPM-88-81 WELL LOG PRESENTED IN APPENDIX
4. SUMMER OAK COVE SUBDIVISION HAS FOUR BEDROCK WELLS WITH APPROXIMATE BEDROCK ELEVATIONS RANGING FROM 639 TO 686 FT., MSL
5. THE WINDINGS SUBDIVISION HAS 12 BEDROCK WELLS WITH APPROXIMATE BEDROCK ELEVATIONS RANGING FROM 557 TO 605 FT., MSL

**FIGURE 2-2**  
**BEDROCK SURFACE CONTOUR PLAN**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.



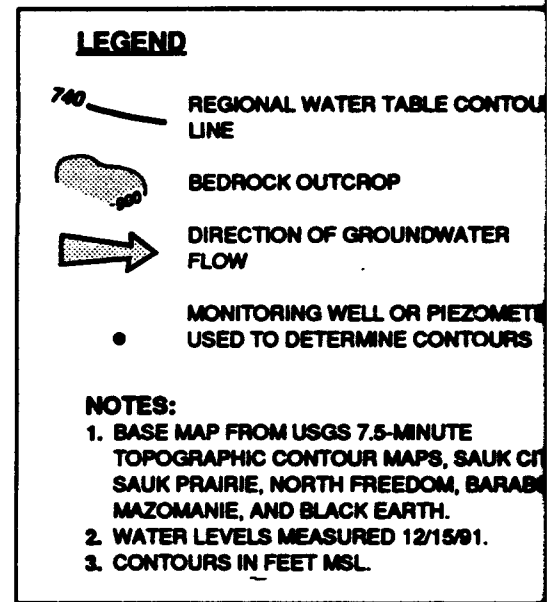








MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION
1	91-88P	787.7	27	NLN-82-05A	774.8	88	S1144	778.1
2	91-88P	776.5	28	91-40P	774.7	89	PBN-82-04A	788.1
3	S1128	778.1	29	91-38P	773.7	90	PBN-82-01A	788.1
4	BGM-91-03	788.2	30	S1113	773.7	91	PBN-82-05	788.1
5	S1128	785.1	31	S1112	772.1	92	S1188	788.1
6	OMM-91-01	785.8	32	S1111	788.8	93	PBN-82-04A	788.1
7	BGM-91-02	788.8	33	S1110	788.8	94	PBN-82-08	788.1
8	BGM-91-01	814.5	34	S1115	770.8	95	PBN-82-08	788.1
9	S1127	824.4	35	S1118	773.8	96	PBN-82-12A	788.1
10	OPM-89-03	778.9	36	RPM-91-01	773.8	97	S1101	788.1
11	S1132	777.4	37	S1188	774.2	98	S1147	788.1
12	OPM-89-02	777.9	38	RPM-91-01	774.8	99	S1148	788.1
13	S1151	777.9	39	RPM-91-02	774.8	100	S1102	788.1
14	ELM-89-05	777.5	40	S1119	775.5	101	S1149	788.1
15	S1183	777.1	41	NPM-91-01	778.1	102	S1104	788.1
16	DBN-89-02A	777.0	42	S1124	778.5	103	SPN-89-05A	788.1
17	ELN-91-07A	778.9	43	NAN-91-01A	777.1	104	SWN-91-02B	788.1
18	91-48P	777.0	44	S1180	778.8	105	SWN-91-04C	788.1
19	91-47P	778.2	45	S1125	777.0	106	SWN-91-03B	788.1
20	91-48P	778.2	46	PBN-89-11	773.9	107	SWN-91-02C	788.1
21	91-45P	778.5	47	LOM-91-02	773.7	108	SWN-91-01B	788.1
22	91-44P	778.5	48	LOM-91-01	772.8	109	SWN-91-01C	788.1
23	91-42P	778.0	49	PBN-89-09	772.2	110	PBN-91-02B	788.1
24	91-43P	775.5	50	LOM-89-01	771.7	111	PBN-91-03B	788.1
25	S1121	775.2	51	LOM-89-03A	771.1	112	PBN-89-04B	788.1
26	NLN-82-01A	775.0	52	PBN-82-02A	771.4			





**FIGURE 1**  
REGIONAL WATER TABLE CONTOURS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT  
ABB Environmental Services





MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION
1	91-88P	787.7	27	NLN-82-05A	774.8	83	S1144	770.8
2	91-88P	778.5	28	91-40P	774.7	84	PBN-82-04A	788.2
3	S1123	778.1	29	91-38P	773.7	85	PBN-85-01A	788.8
4	BGM-91-03	783.2	30	S1113	773.7	86	PBN-89-05	788.0
5	S1126	785.1	31	S1112	772.1	87	S1109	788.7
6	QAM-91-01	785.8	32	S1111	788.8	88	PBN-85-04A	788.8
7	BGM-91-02	788.8	33	S1110	788.0	89	PBN-89-08	788.1
8	BGM-91-01	814.5	34	S1115	770.8	90	PBN-85-08	785.3
9	S1127	824.4	35	S1118	773.8	91	PBN-89-12A	784.4
10	OPM-89-03	778.9	36	RPM-91-01	773.8	92	S1101	781.9
11	S1132	777.4	37	S1120	774.2	93	S1147	782.3
12	OPM-89-02	777.9	38	RPM-89-01	774.8	94	S1148	781.9
13	S1151	777.9	39	RPM-89-02	774.8	95	S1102	781.7
14	ELM-89-05	777.5	40	S1119	775.5	96	S1149	782.7
15	S1183	777.1	41	NPM-89-01	778.1	97	S1104	782.4
16	DBN-89-02A	777.0	42	S1124	778.5	98	SPN-89-05A	782.7
17	ELN-91-07A	778.9	43	NAN-91-01A	777.1	99	SWN-91-05B	748.3
18	91-48P	777.0	44	S1150	778.8	70	SWN-91-04C	780.9
19	91-47P	778.2	45	S1125	777.0	71	SWN-91-03B	782.3
20	91-48P	778.2	46	PBM-89-11	773.9	72	SWN-91-02C	783.8
21	91-45P	778.5	47	LOM-91-02	773.7	73	SWN-91-01B	784.8
22	91-44P	778.5	48	LOM-91-01	772.8	74	PBN-91-01C	743.0
23	91-42P	776.0	49	PBM-89-09	772.2	75	PBN-91-02B	742.9
24	91-43P	775.5	50	LOM-89-01	771.7	76	PBN-91-03B	742.1
25	S1121	775.2	51	LON-89-03A	771.1	77	PBN-89-04B	738.8
26	NLN-82-01A	775.0	52	PBN-82-02A	771.4			

#### LEGEND

- 740 — REGIONAL WATER TABLE CONTOUR LINE
-  BEDROCK OUTCROP
-  DIRECTION OF GROUNDWATER FLOW
- MONITORING WELL OR PIEZOMETER USED TO DETERMINE CONTOURS

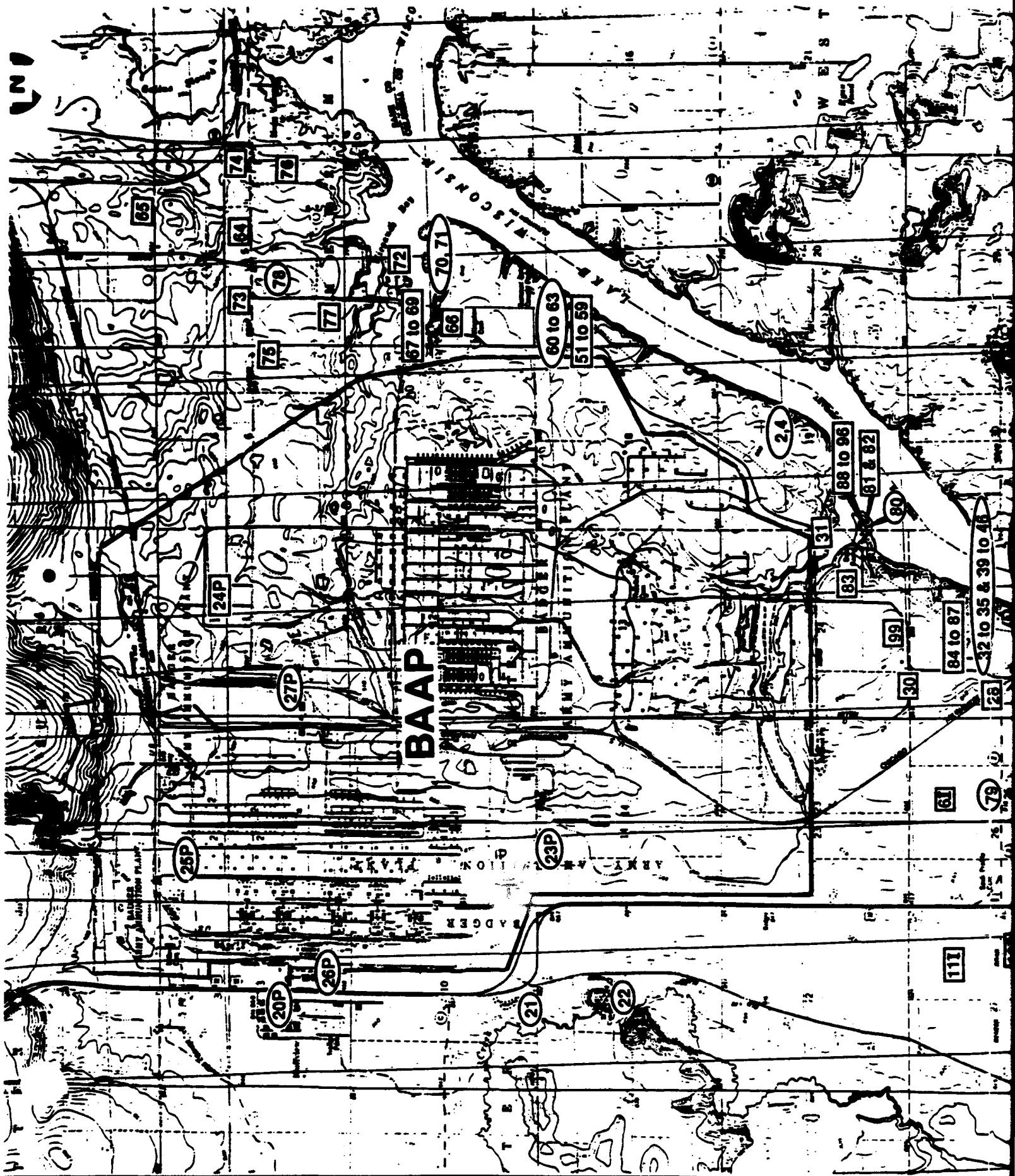
#### NOTES:

1. BASE MAP FROM USGS 7.5-MINUTE TOPOGRAPHIC CONTOUR MAPS, SAUK CITY, SAUK PRAIRIE, NORTH FREEDOM, BARABOO, MAZOMANIE, AND BLACK EARTH.
2. WATER LEVELS MEASURED 12/15/91.
3. CONTOURS IN FEET MSL.

**FIGURE 2-3**  
**REGIONAL WATER TABLE CONTOUR PLAN**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.











# LEGEND

DESIGNATION AND APPROXIMATE LOCATION  
OF WATER SUPPLY WELL SCREENED IN SAND  
AND GRAVEL AQUIFER

DESIGNATION AND APPROXIMATE LOCATION  
OF WATER SUPPLY WELL INSTALLED IN  
BEDROCK

## NOTES:

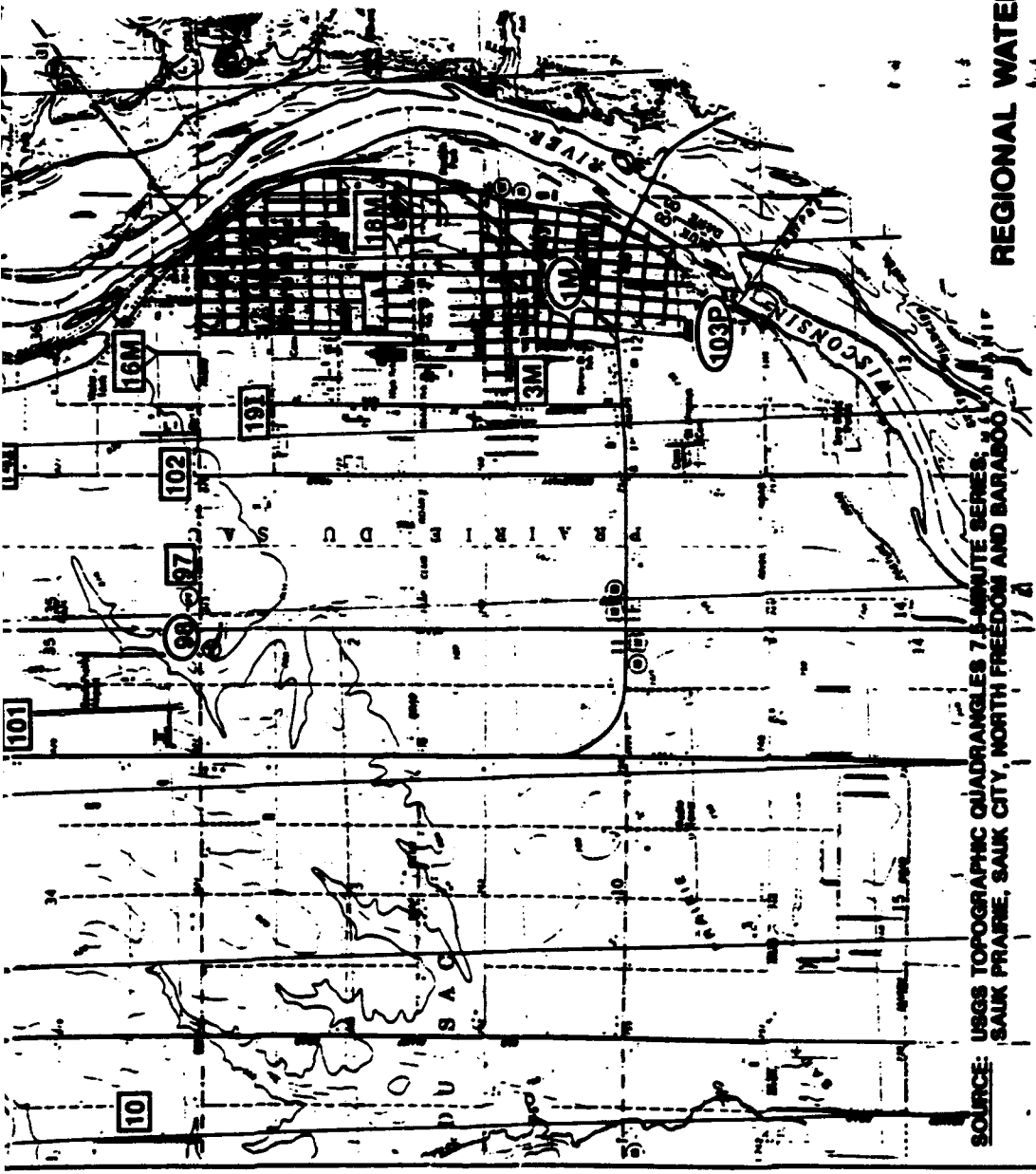
1. ALL WELL LOCATIONS ARE BASED UPON DRILLERS RECORDS AND HAVE QUESTIONABLE ACCURACY.
2. I - INDICATES HIGH CAPACITY IRRIGATION WELL.  
P - INDICATES HIGH CAPACITY PRODUCTION WELL.  
M - INDICATES HIGH CAPACITY MUNICIPAL WELL.  
ALL OTHER WELLS ARE FOR RESIDENTIAL SUPPLY.
3. DRILLERS LOGS AND RECORDS OBTAINED FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES AND WISCONSIN GEOLOGIC AND NATURAL HISTORY SURVEY. RECORDS AND LOGS ARE INCLUDED IN APPENDIX D.

**FIGURE 2-4**  
**REGIONAL WATER SUPPLY AND IRRIGATION WELLS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
ABS Environmental Services, Inc.

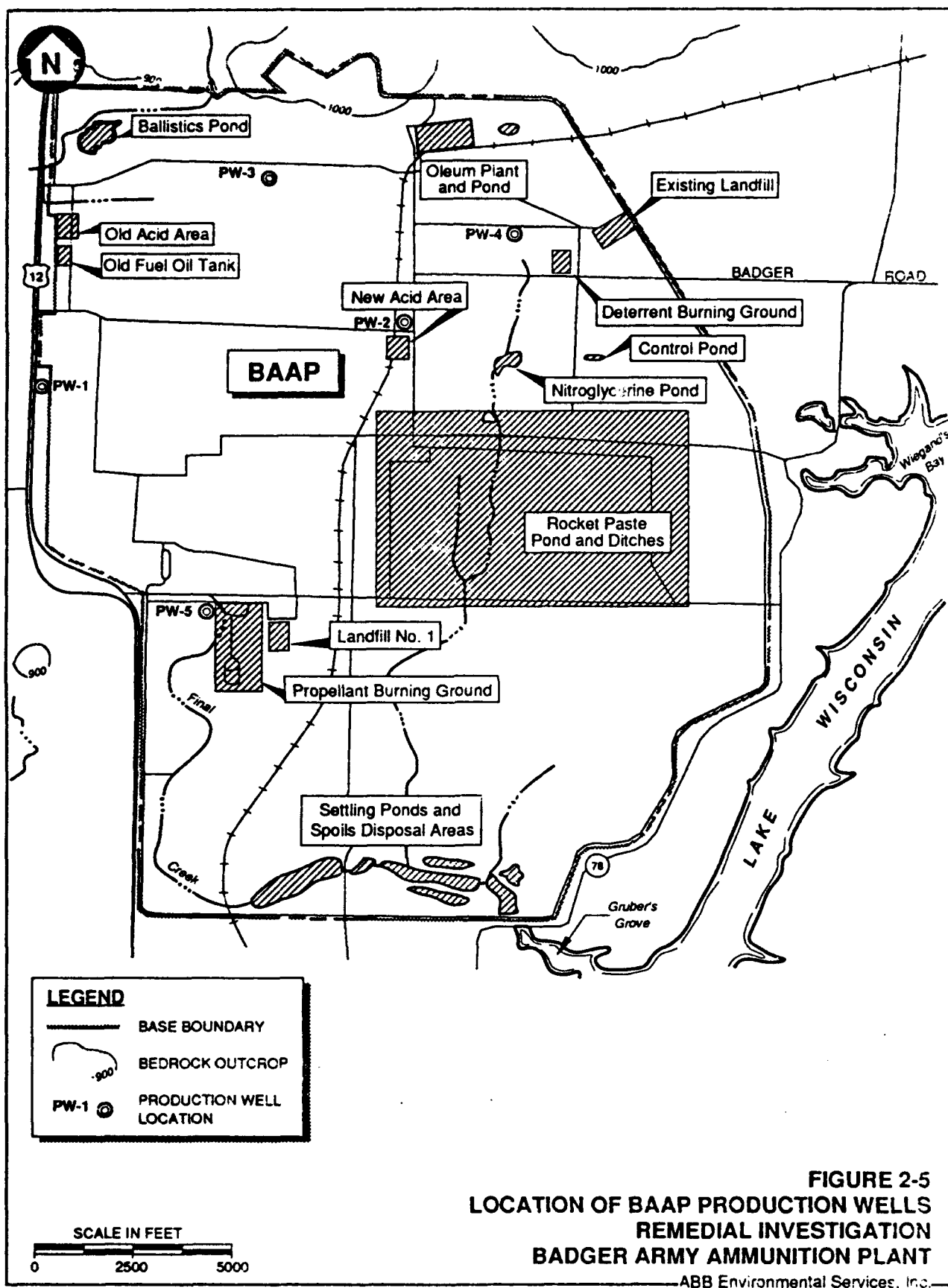
SOURCE: USGS TOPOGRAPHIC QUADRANGLES 7.5-MINUTE SERIES:  
SAUK PRARIE, SAUK CITY, NORTH FREEDOM AND BARABOO



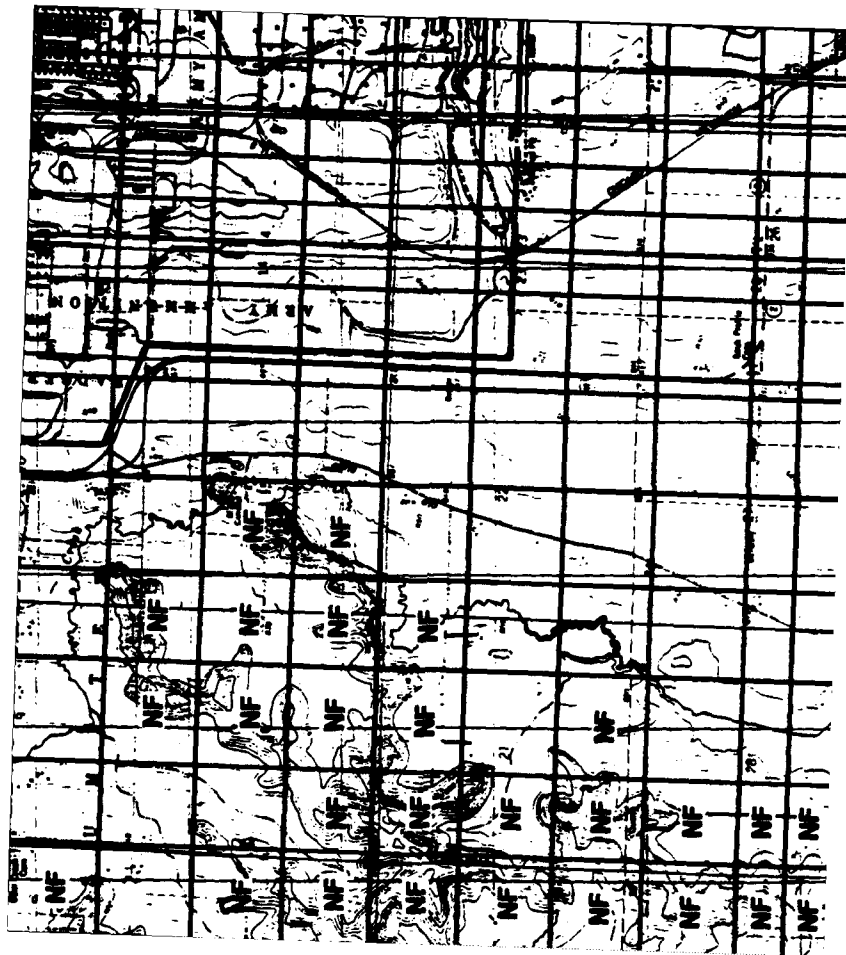
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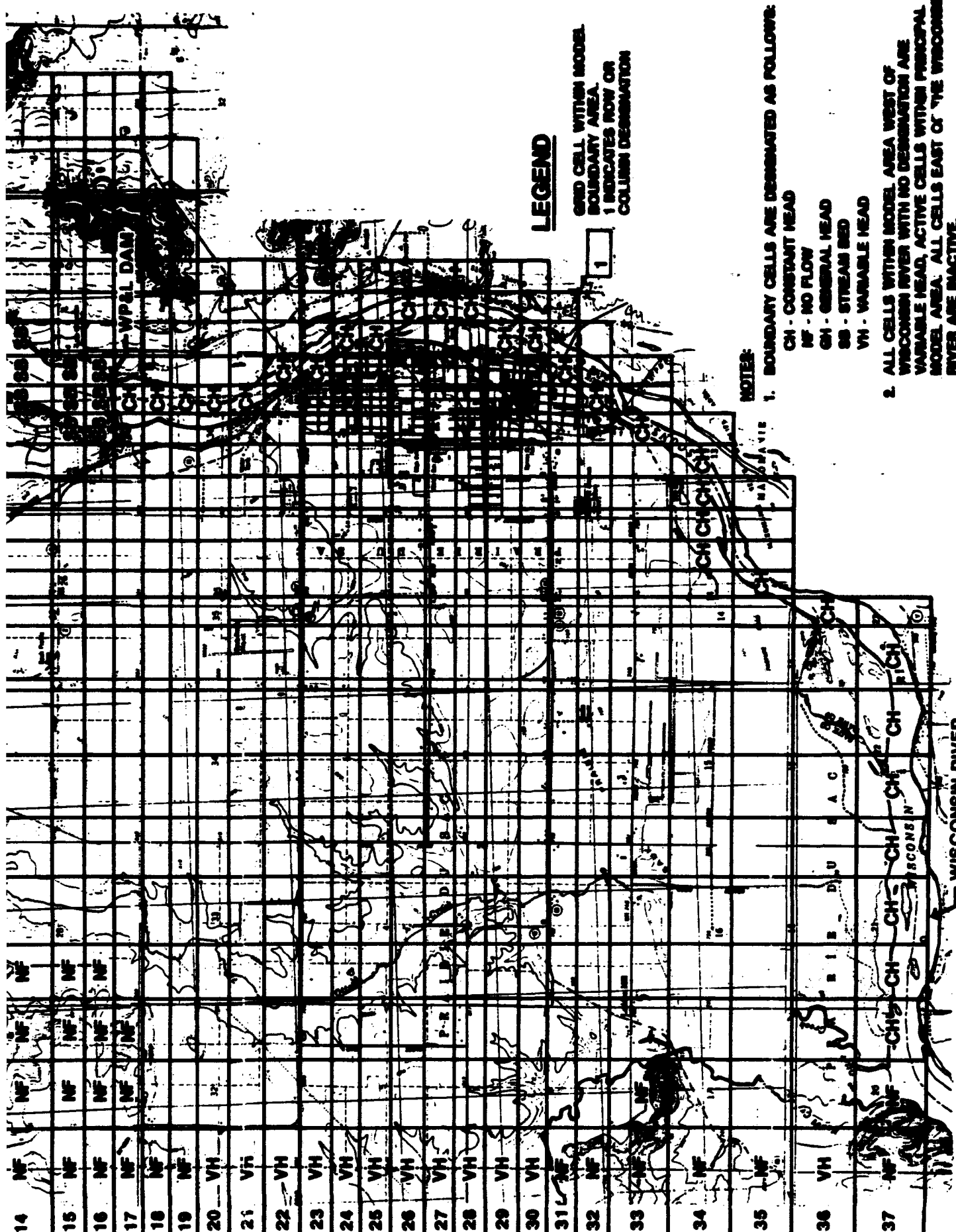












# **LEGEND**

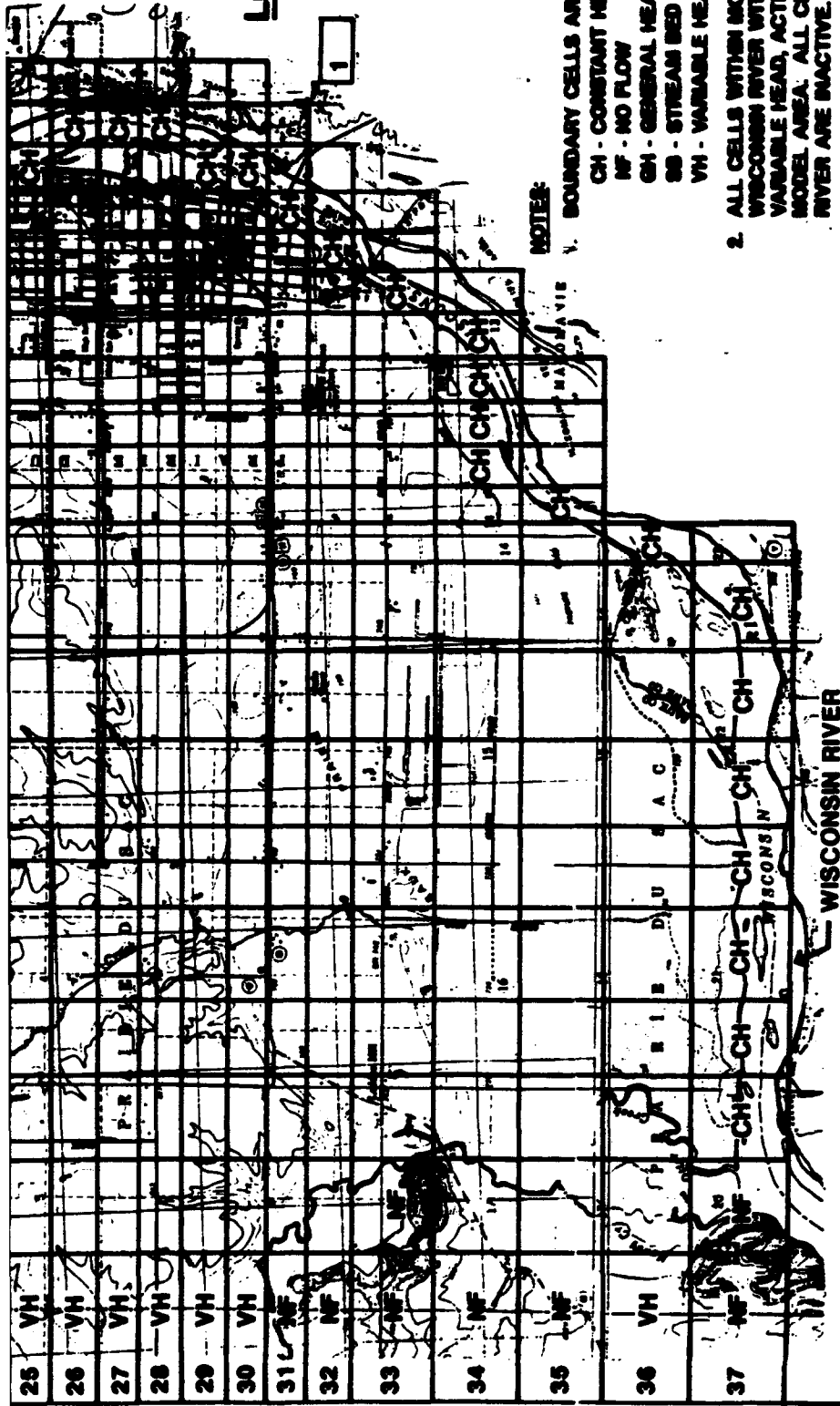
GRID CELL WITHIN MODEL  
BOUNDARY AREA  
1 INDICATES ROW OR  
COLUMN DESIGNATION

## **NOTES:**

1. BOUNDARY CELLS ARE DESIGNATED AS FOLLOWS:  
CH - CONSTANT HEAD  
NF - NO FLOW  
VH - VARIABLE HEAD  
CH - STREAM BED
2. ALL CELLS WITHIN MODEL AREA WEST OF  
WISCONSIN RIVER WITH NO DESIGNATION ARE  
VARIABLE HEAD, ACTIVE CELLS WITHIN PRINCIPAL  
MODEL AREA. ALL CELLS EAST OF THE WISCONSIN  
RIVER ARE INACTIVE.
3. GALLUS SLOUGH IS LOCATED APPROXIMATELY  
2,000 FEET EAST OF MODEL BOUNDARY.

WISCONSIN RIVER





# **LEGEND**

GRID CELL WITHIN MODEL  
BOUNDARY AREA.  
1 INDICATES ROW OR  
COLUMN DESIGNATION

## **NOTES:**

1. BOUNDARY CELLS ARE DESIGNATED AS FOLLOWS:

CH - CONSTANT HEAD

NF - NO FLOW

GH - GENERAL HEAD

SB - STREAM BED

VH - VARIABLE HEAD

2. ALL CELLS WITHIN MODEL AREA WEST OF  
WISCONSIN RIVER WITH NO DESIGNATION ARE  
VARIABLE HEAD. ACTIVE CELLS WITHIN PRINCIPAL  
MODEL AREA. ALL CELLS EAST OF THE WISCONSIN  
RIVER ARE INACTIVE.

3. GALLUS SLOUGH IS LOCATED APPROXIMATELY  
2,000 FEET EAST OF MODEL BOUNDARY.

SOURCE: USGS TOPOGRAPHIC QUADRANGLES 7.5-MINUTE SERIES;  
SAUK PRAIRIE, SAUK CITY, NORTH FREEDOM AND BARABOO.

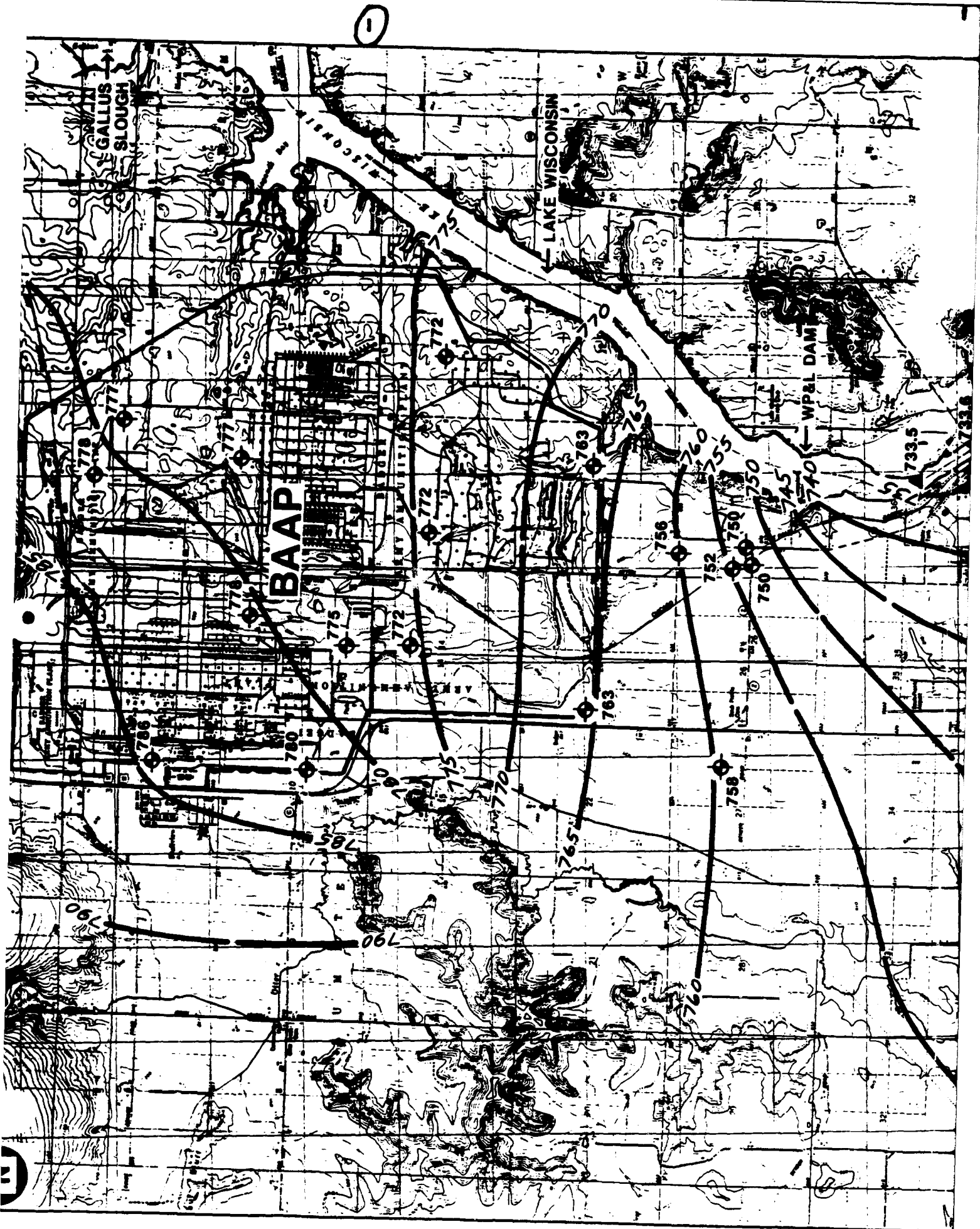
SCALE IN FEET



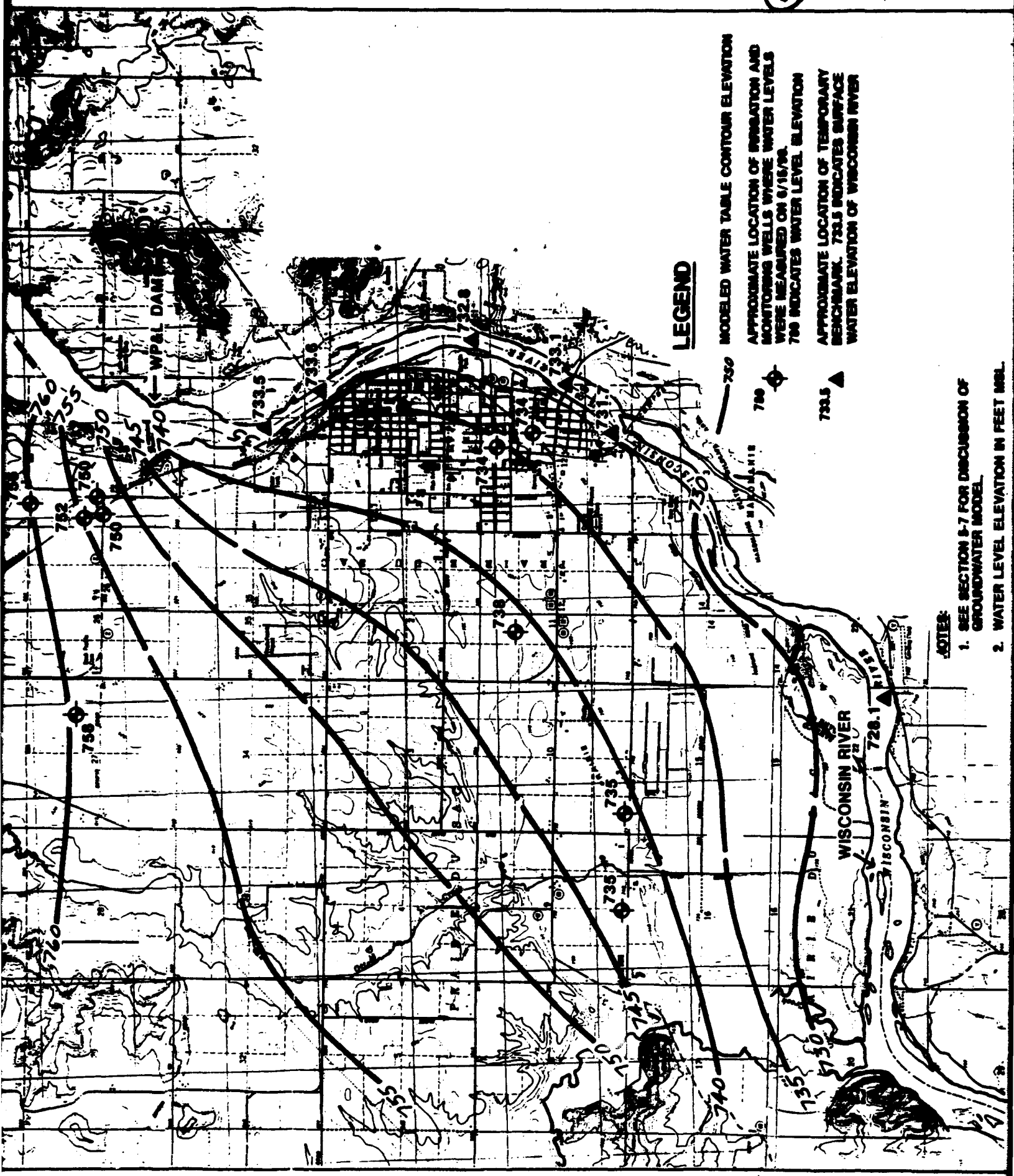
## **FIGURE 2-6 GROUNDWATER FLOW MODEL GRID REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT**

AGS Environmental Services, Inc.







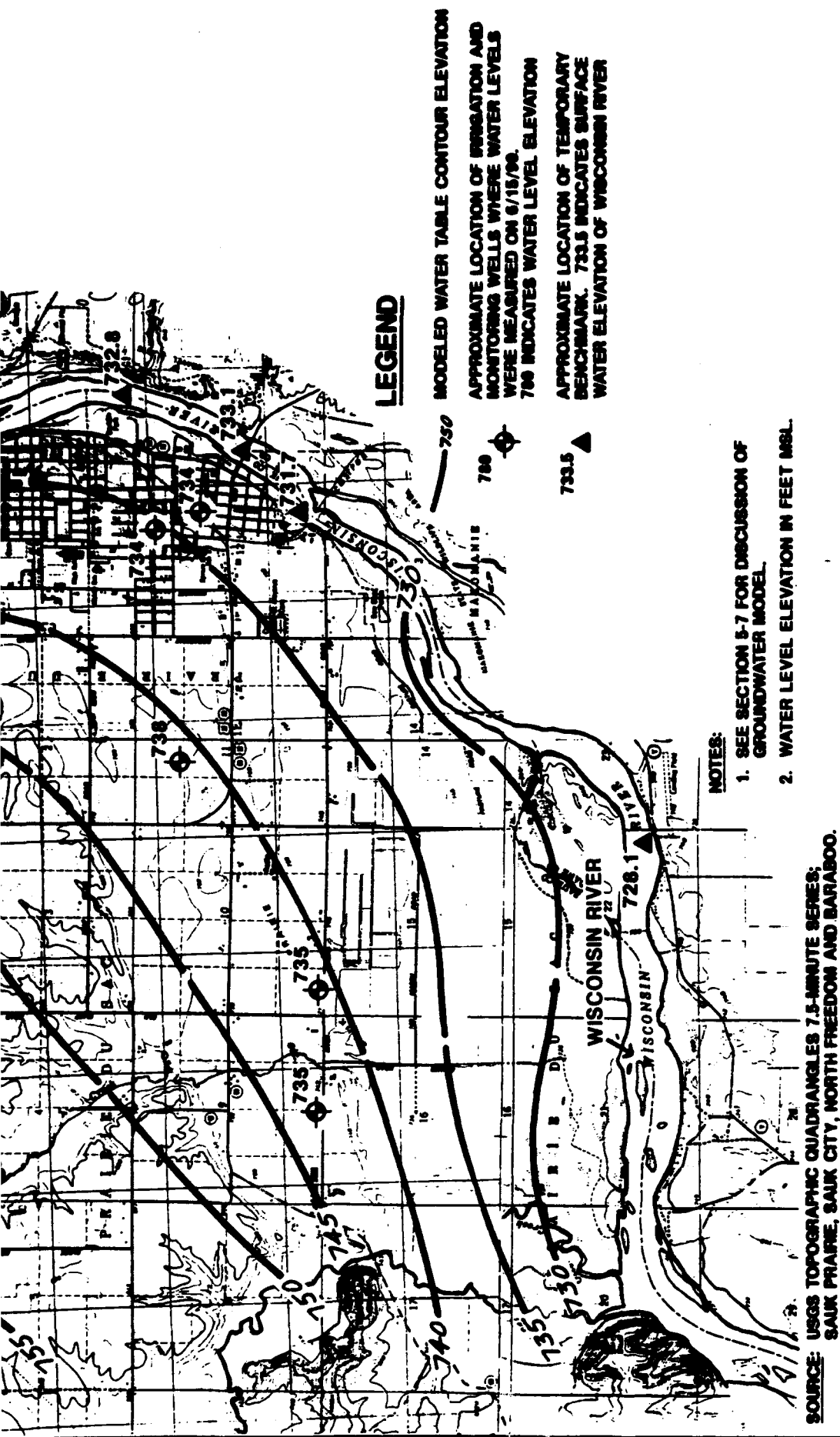


**LEGEND**

- MODELED WATER TABLE CONTOUR ELEVATION
- APPROXIMATE LOCATION OF IRRIGATION AND MONITORING WELLS WHERE WATER LEVELS WERE MEASURED ON 8/15/98
- 780 INDICATES WATER LEVEL ELEVATION
- APPROXIMATE LOCATION OF TEMPORARY BENCHMARK. 733.5 INDICATES SURFACE WATER ELEVATION OF WISCONSIN RIVER

- NOTES:**
1. SEE SECTION 5-7 FOR DISCUSSION OF GROUNDWATER MODEL.
  2. WATER LEVEL ELEVATION IN FEET MSL.

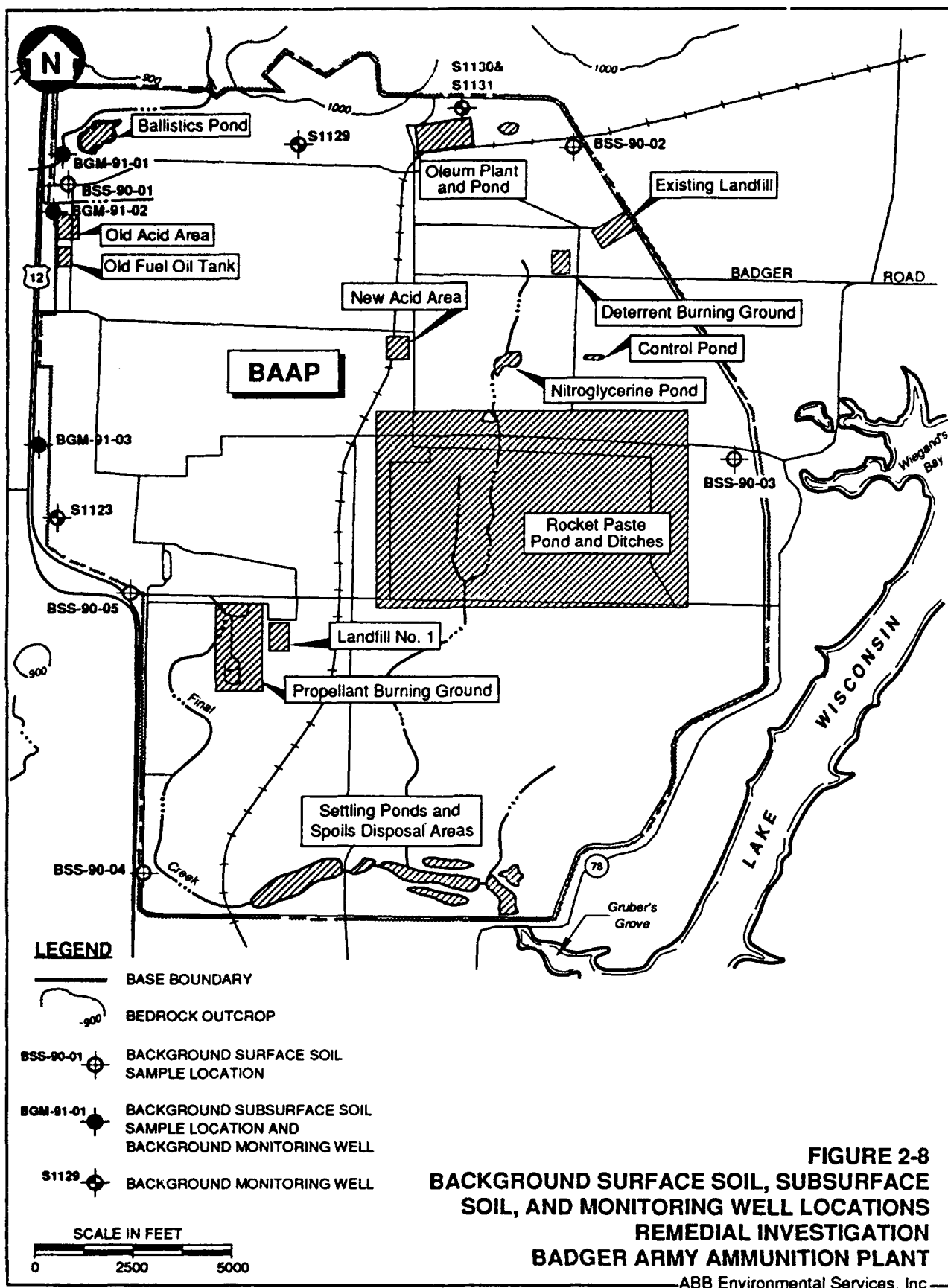




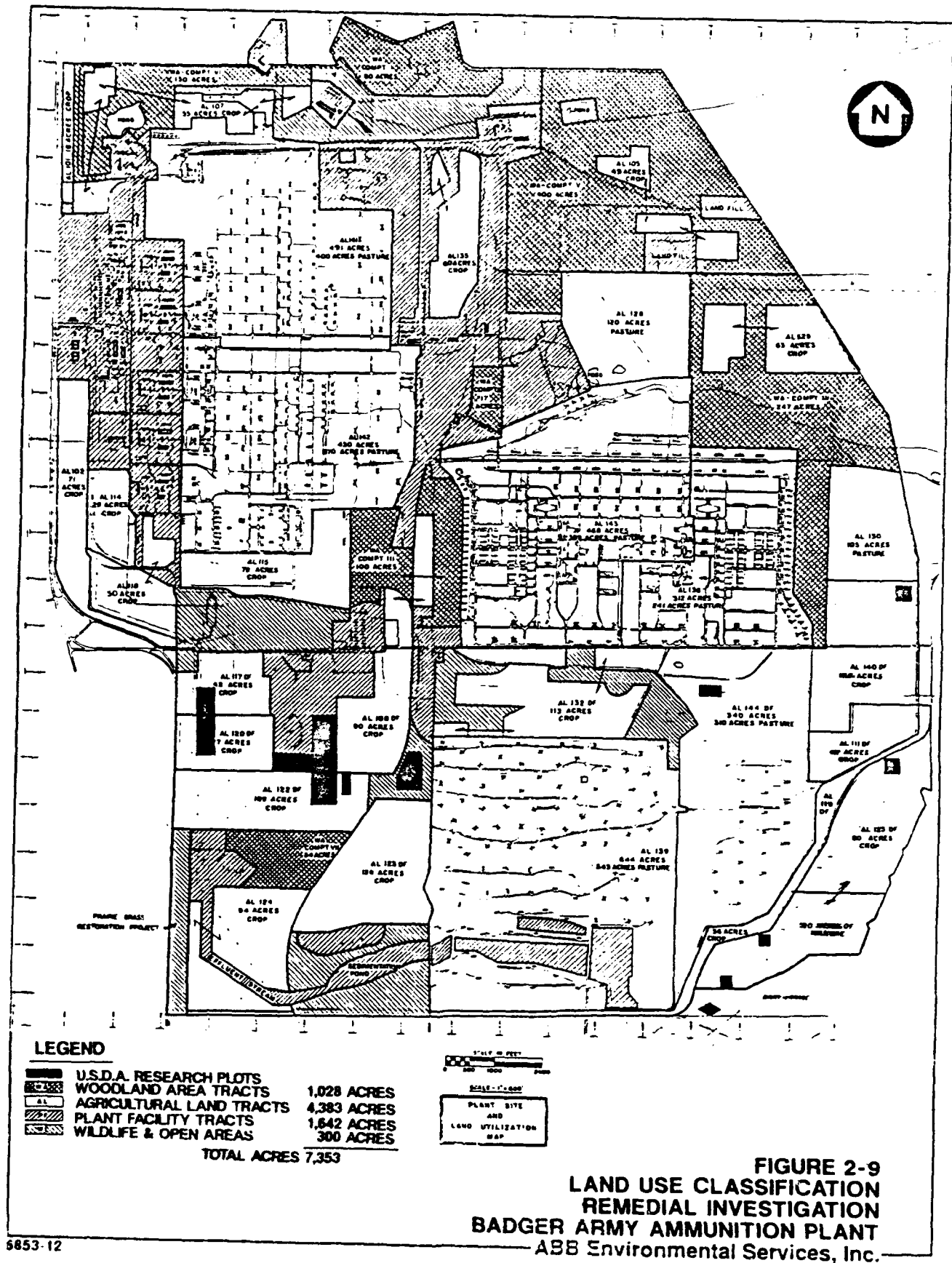
**SOURCE:** USGS TOPOGRAPHIC QUADRANGLES 7.5-MINUTE SERIES;  
SAUK PRAIRIE, SAUK CITY, NORTH FREEDOM AND BARABOO.

**6953-12**











**TABLE 3-1**  
**CHECKLIST OF SWMU ENVIRONMENTAL SETTING AND FEATURES**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SWMU</b>	<b>WETLANDS</b>	<b>SURFACE WATER</b>	<b>SURFACE IMPOUNDMENT</b>	<b>LANDFILL</b>	<b>ABOVEGROUND STORAGE TANK</b>
Propellant Burning Ground				X	X (propane)
Deterrent Burning Ground				X	
Existing Landfill				X	
Settling Ponds and Spoils Disposal Area	X	X	X	X	
Ballistics Pond	X	X			
Oleum Plant and Pond	X	X			
Nitroglycerine Pond	X	X			
Rocket Paste Area	X	X			
Old Acid Area					X (acids)
New Acid Area			X		X (acids)
Old Fuel Oil Tank					X (fuel)

**Note:**

The landfill at the Propellant Burning Ground is known as Landfill 1, and is considered a separate SWMU.



**TABLE 3-2**  
**POTENTIAL LOCATION-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARS/CITATION
<b>Propellant Burning Ground</b>	<p><u>LANDFILL</u></p> <p>Resource Conservation and Recovery Act (RCRA), Subpart N, Landfills; (40 CFR Section 264.300)</p> <p>WDNR, Solid Waste Management Regulations (WAC, Chapters 504-516)</p> <p>WDNR, Hazardous Waste Landfill Standards (WAC, Chapter 660)</p> <p><u>AIR</u></p> <p>Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR Part 52.21)</p>
<b>Deterrent Burning Ground</b>	<p><u>LANDFILL</u></p> <p>RCRA, Subpart N, Landfills; (40 CFR Section 264.300)</p> <p>WDNR, Solid Waste Management Regulations (WAC, Chapters 504-516)</p> <p>WDNR, Hazardous Waste Landfill Standards (WAC, Chapter 660)</p> <p><u>AIR</u></p> <p>Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)</p>
<b>Existing Landfill</b>	<p><u>LANDFILL</u></p> <p>RCRA, Subpart N, Landfills; (40 CFR Section 264.300)</p> <p>WDNR, Solid Waste Management Regulations (WAC, Chapters 504-516)</p> <p>WDNR, Hazardous Waste Landfill Standards (WAC, Chapter 660)</p> <p><u>AIR</u></p> <p>Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)</p>



continued

**TABLE 3-2  
POTENTIAL LOCATION-SPECIFIC  
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARs/CITATION
<b>Settling Ponds and Spoils Disposal Area</b>	<u><b>WETLANDS</b></u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)
	Clean Water Act (CWA), Dredge or Fill Requirements; (Section 404), 40 CFR 230
	U.S. Army Corps of Engineers Permit Program Regulations; (33 CFR Parts 320-330)
	Fish and Wildlife Coordination Act; (40 CFR 302(g))
	National Environmental Policy Act (NEPA) - Protection of Wetlands Exec. Order No. 11990; (40 CFR Part 6)
	WDNR, Water Quality Standards for Wetlands (WAC, Chapter NR 103)
	WDNR, City and Village Shoreland-Wetland Protection Program (WAC, Chapter NR 117)
	WDNR, Hazardous Waste Storage, Treatment, and Disposal Facility Standards (WAC, NR 630)
	<u><b>SURFACE WATER</b></u>
	WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter NR 102)
	WDNR, Water Quality Standards for Wisconsin Waters; Uses and Designated Standards (WAC, Chapter NR 104)
	WDNR, Shoreline Management Program (WAC, Chapter 115)
	WDNR, Wisconsin Statutes Annotated, Chapter 30, Dredge and Fill Requirements
	City of Baraboo Floodplain Zoning Code (Subchapter II)
	<u><b>LANDFILL</b></u>
	RCRA, Subpart N, Landfills; (40 CFR Section 264.300)
	WDNR, Solid Waste Management Regulations (WAC, Chapters 504-516)
	WDNR, Hazardous Waste Landfill Standards (WAC, Chapter 660)



continued

**TABLE 3-2  
POTENTIAL LOCATION-SPECIFIC  
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARS/CITATION
<b>Ballistics Pond</b>	<u><b>WETLANDS</b></u>
	Clean Water Act, Dredge or Fill Requirements; (Section 404), 40 CFR 230
	U.S. Army Corps of Engineers Permit Program Regulations; (33 CFR Parts 320-330)
	Fish and Wildlife Coordination Act; (40 CFR 302(g))
	NEPA - Protection of Wetlands Exec. Order No. 11990; (40 CFR Part 6)
	WDNR, Water Quality Standards for Wetlands (WAC, Chapter NR 103)
	WDNR, City and Village Shoreland-Wetland Protection Program (WAC, Chapter NR 117)
	WDNR, Hazardous Waste Storage, Treatment, and Disposal Facility Standards (WAC, NR 630)
	<u><b>SURFACE WATER</b></u>
	WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter NR 102)
	WDNR, Water Quality Standards for Wisconsin Waters; Uses and Designated Standards (WAC, Chapter NR 104)
	WDNR, Shoreline Management Program (WAC, Chapter 115)
	WDNR, Wisconsin Statutes Annotated, Chapter 30, Dredge and Fill Requirements
	City of Baraboo Floodplain Zoning Code (Subchapter II)
	<u><b>AIR</b></u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)



**TABLE 3-2**  
**POTENTIAL LOCATION-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARs/CITATION
<b>Oleum Plant and Pond</b>	<p><u><b>WETLANDS</b></u></p> <p>Clean Water Act (CWA), Dredge or Fill Requirements; (Section 404), 40 CFR 230</p> <p>U.S. Army Corps of Engineers Permit Program Regulations; (33 CFR Parts 320-330)</p> <p>Fish and Wildlife Coordination Act; (40 CFR 302(g))</p> <p>NEPA - Protection of Wetlands Executive Order Number 11990; (40 CFR Part 6)</p> <p>WDNR, Water Quality Standards for Wetlands (WAC, Chapter NR 103)</p> <p>WDNR, City and Village Shoreland-Wetland Protection Program (WAC, Chapter NR 117)</p> <p>WDNR, Hazardous Waste Storage, Treatment, and Disposal Facility Standards (WAC, NR 630)</p> <p><u><b>SURFACE WATER</b></u></p> <p>WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter NR 102)</p> <p>WDNR, Water Quality Standards for Wisconsin Waters; Uses and Designated Standards (WAC, Chapter NR 104)</p> <p>WDNR, Shoreline Management Program (WAC, Chapter 115)</p> <p>WDNR, Wisconsin Statutes Annotated, Chapter 30, Dredge and Fill Requirements</p> <p>City of Baraboo Floodplain Zoning Code (Subchapter II)</p> <p><u><b>AIR</b></u></p> <p>Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)</p>



continued

**TABLE 3-2**  
**POTENTIAL LOCATION-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITE</b>	<b>POTENTIAL ARARs/CITATION</b>
<b>Nitroglycerine Pond</b>	<u><b>WETLANDS</b></u>
	Clean Water Act, Dredge or Fill Requirements; (Section 404), 40 CFR 230
	U.S. Army Corps of Engineers Permit Program Regulations; (33 CFR Parts 320-330)
	Fish and Wildlife Coordination Act; (40 CFR 302(g))
	NEPA - Protection of Wetlands Exec. Order No. 11990; (40 CFR Part 6)
	WDNR, Water Quality Standards for Wetlands (WAC, Chapter NR 103)
	WDNR, City and Village Shoreland-Wetland Protection Program (WAC, Chapter NR 117)
	WDNR, Hazardous Waste Storage, Treatment, and Disposal Facility Standards (WAC, NR 630)
	<u><b>SURFACE WATER</b></u>
	WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter NR 102)
	WDNR, Water Quality Standards for Wisconsin Waters; Uses and Designated Standards (WAC, Chapter NR 104)
	WDNR, Shoreline Management Program (WAC, Chapter 115)
	WDNR, Wisconsin Statutes Annotated, Chapter 30, Dredge and Fill Requirements
	City of Baraboo Floodplain Zoning Code (Subchapter II)
	<u><b>AIR</b></u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)



continued

**TABLE 3-2**  
**POTENTIAL LOCATION-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARs/CITATION
<b>Rocket Paste Area</b>	<u><b>WETLANDS</b></u>
	Clean Water Act, Dredge or Fill Requirements; (Section 404), 40 CFR 230
	U.S. Army Corps of Engineers Permit Program Regulations; (33 CFR Parts 320-330)
	Fish and Wildlife Coordination Act; (40 CFR 302(g))
	NEPA - Protection of Wetlands Exec. Order No. 11990; (40 CFR Part 6)
	WDNR, Water Quality Standards for Wetlands (WAC, Chapter NR 103)
	WDNR, City and Village Shoreland-Wetland Protection Program (WAC, Chapter NR 117)
	WDNR, Hazardous Waste Storage, Treatment, and Disposal Facility Standards (WAC, NR 630)
	<u><b>SURFACE WATER</b></u>
	WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter NR 102)
	WDNR, Water Quality Standards for Wisconsin Waters; Uses and Designated Standards (WAC Chapter NR 104)
	WDNR, Shoreline Management Program (WAC, Chapter 115)
	WDNR, Wisconsin Statutes Annotated, Chapter 30, Dredge and Fill Requirements
	City of Baraboo Floodplain Zoning Code (Subchapter II)
	<u><b>AIR</b></u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)
<b>Old Acid Area</b>	<u><b>AIR</b></u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)



continued

**TABLE 3-2**  
**POTENTIAL LOCATION-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE	POTENTIAL ARARS/CITATION
New Acid Area	<u>SURFACE IMPOUNDMENT</u>
	RCRA, Subpart K, Surface Impoundments; (40 CFR 264.220)
	WDNR, Solid Waste Management Regulations (WAC, Chapters 504-516)
	<u>AIR</u>
	Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)
Old Fuel Oil Tank	<u>ABOVEGROUND STORAGE TANKS</u>
	CWA - Oil Pollution Prevention (40 CFR Part 112)
	<u>AIR</u> Clean Air Act (CAA), Prevention of Significant Deterioration (PSD) Requirements; (40 CFR, Part 52.21)



**TABLE 3-3**  
**POTENTIAL CHEMICAL-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE MEDIA	REQUIREMENT/CITATION
GROUNDWATER	
Federal Regulatory Requirements	<p>Safe Water Drinking Act (SDWA), Maximum Contaminant Level Goals (MCLGs); (40 CFR Part 141)</p> <p>SDWA, National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs); (40 CFR Part 141)</p> <p>RCRA, Releases from Solid Waste Management Units, Groundwater Protection Standards; (40 CFR Part 264.90-264.101, Subpart F)</p>
State Regulatory Requirements	<p>WDNR, Environmental Protection (WAC, Chapter NR 100)</p> <p>WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter 102.14)</p> <p>WDNR, Water Quality Criteria for Toxic Substances (WAC, Chapter 105)</p> <p>WDNR, Procedures for Calculating Water-quality-based Effluent Limitations for Toxic and Organoleptic Substances Discharged to Surface Water (WAC, Chapter NR 106)</p> <p>WDNR, Groundwater Quality Standards (WAC, Chapter 140)</p> <p>WDNR, Pollutant Discharge Elimination System Standards for Uncategorized Point Sources (WAC, Chapter 220.20)</p> <p>WDNR, Groundwater Standards for Hazardous Waste; Groundwater and Leachate Monitoring Standards and Corrective Action Requirements (WAC, Chapter 635)</p>
Federal Criteria, Advisories, and Guidance	<p>Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC); (40 CFR Part 131 Quality Criteria for Water, 1986)</p> <p>SDWA, National Secondary Drinking Water Standards (SMCLs); (40 CFR Part 143)</p> <p>EPA Reference Doses (RfDs)</p> <p>EPA Reference Concentrations (RfCs)</p> <p>EPA Human Health Assessment Cancer Slope Factors (CSFs)</p> <p>EPA Office of Drinking Water, Health Advisories</p> <p>EPA Health Assessment Documents, Acceptable Intake - Chronic (AIC) and Subchronic (AIS)</p> <p>EPA, Office of Water Guidance, Water-Related Fate of 129 Priority Pollutants (1979)</p>



continued

**TABLE 3-3**  
**POTENTIAL CHEMICAL-SPECIFIC**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE MEDIA	REQUIREMENT/CITATION
<b>SURFACE WATER</b>  Federal Regulatory Requirements	CWA, National Pollutant Discharge Elimination System (NPDES); (40 CFR Part 122, 125)  CWA, Ambient Water Quality Criteria (AWQC); (40 CFR Part 131 Quality Criteria for Water, 1986)
State Regulatory Requirements	WDNR, Water Quality Standards for Wisconsin Waters (WAC, Chapter 102.14)  WDNR, Water Quality Criteria for Toxic Substances (WAC, Chapter 105)  WDNR, Procedures for Calculating Water-quality-based Effluent Limitations for Toxic and Organoleptic Substances Discharged to Surface Water (WAC, Chapter NR 106)  WDNR, Pollutant Discharge Elimination System Standards for Uncategorized Point Sources (WAC, Chapter 220.20)
Discharge to Publicly Owned Treatment Works	CWA, National Pretreatment Standards; (40 CFR Part 403) Discharge to Publicly Owned Treatment Works
SOIL	Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites; [OSWER Directive #9355.4-02]
SEDIMENT	No chemical-specific ARARs identified for this media.
<b>AIR</b>  Federal Regulatory Requirements   State Regulatory Requirements	Clean Air Act (CAA), National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50)  CAA - National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)  CAA - Hazardous Air Pollutants (HAPs) (CAA, Title III)  WDNR; Wisconsin General and Portable Sources Air Pollution Control Rules; Ambient Air Quality Standards (WAC, Chapter NR 404)  WDNR; Wisconsin Particulate and Sulfur Emissions Rules; Control of Particulate Emissions (WAC, Chapter NR 415)  WDNR; Wisconsin Organic Compound Emissions Rules (WAC, Chapter NR 419)  WDNR; Wisconsin Hazardous Air Pollutants Emissions Standards (WAC, Chapter NR 445)



**TABLE 3-4**  
**GROUNDWATER CHEMICAL SPECIFIC STANDARDS AND GUIDANCE**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITIONS PLANT**

CHEMICAL		SAFE DRINKING WATER ACT (SDWA) (d)		CWA WATER QUALITY CRITERIA (c)				WI PUBLIC HEALTH GROUNDWATER QUALITY STANDARDS (b)			
				FOR PROTECTION OF HUMAN HEALTH		FOR PROTECTION OF AQUATIC LIFE					
CHEMICAL CODE	CHEMICAL NAME	MCL (µg/l) (a)	MCLG (µg/l)	WATER AND FISH CONSUMPTION (µg/l)	FISH CONSUMPTION ONLY (µg/l)	FRESHWATER ACUTE/CHRONIC (µg/l)	MARINE ACUTE/CHRONIC (µg/l)	CURRENT STANDARDS ENFORCEMENT STANDARDS (µg/l)	PAL (µg/l)	PROPOSED STANDARDS ENFORCEMENT STANDARDS (µg/l)	PAL (µg/l)
ACRYLO	acrylonitrile	-	-	0.058	0.85	7,500/2,600 (10)	-/-	-	-	-	-
AL	aluminum	50-200 (1)	-	(2)	(2)	(2)	(2)	-	-	-	-
ALK	alkalinity	-	-	-	-	- / 20 ppm	-/-	-	-	-	-
AS	arsenic	50 (3)	-	0.0022	0.0175	-/-	-/-	50	5	-	-
B2EHP	bis(2 ethylhexyl) phthalate	4 (4)	0	15,000	50,000	400/300 (4)	400/360 (4)	3	0.3	-	-
BA	barium	2,000	2,000	1,000	-	-/-	-/-	1,000	200	2,000	400
C2H3CL	vinyl chloride	2	0	2	525	-/-	-/-	0.2	0.0015	-	0.01
C6H6	benzene	5	0	0.66	40	5,300/- (5)	5,100/700 (5)	5	0.067	-	0.5
CA	calcium	-	-	-	-	-/-	-/-	-	-	-	-
CCl4	carbon tetrachloride	5	0	0.4	6.94	35,200/- (5)	50,000/- (5)	5	0.5	-	-
CD	cadmium	5	5	10	-	3.9/1.1 (4)	43/9.3	10	1	5	0.5
CHCL3	chloroform	100 (6)	-	0.19	15.7	28,900/1,240(5)	-/-	6	0.6	-	-
Cl	chloride	250,000 (7)	-	-	-	860,000/230,000	-/-	250,000 (7)	125,000 (7)	-	-
CO	cobalt	-	-	-	-	-/-	-/-	-	-	-	-
Cr	chromium (total)	100	100	-	-	-/-	-/-	50	5	100	10
C2S	carbon disulfide	-	-	-	-	-/-	-/-	-	-	-	-
1,2-DCE	1,2-dichloroethane	5	0	0.91	243	118,000/20,000 (5)	11,300/- (5)	5	0.05	-	0.5
DHP	diethylphthalate	-	-	350,000	1,900,000	-/-	-/-	-	-	-	-
DBP	di n butyl phthalate	-	-	34,000	154,000	-	-/-	-	-	-	-



continued

TABLE 3-4  
GROUNDWATER CHEMICAL SPECIFIC STANDARDS AND GUIDANCE  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITIONS PLANT

CHEMICAL CODE	CHEMICAL NAME	SAFE DRINKING WATER ACT (SDWA) (d)		CWA WATER QUALITY CRITERIA (c)				WI PUBLIC HEALTH GROUNDWATER QUALITY STANDARDS (b)			
		MCL ( $\mu\text{g/l}$ ) (a)	MCLG ( $\mu\text{g/l}$ )	FOR PROTECTION OF HUMAN HEALTH		FOR PROTECTION OF AQUATIC LIFE		CURRENT STANDARDS		PROPOSED STANDARDS	
				WATER AND FISH CONSUMPTION ( $\mu\text{g/l}$ )	FISH CONSUMPTION ONLY ( $\mu\text{g/l}$ )	FRESHWATER ACUTE/CHRONIC ( $\mu\text{g/l}$ )	MARINE ACUTE/CHRONIC ( $\mu\text{g/l}$ )	ENFORCEMENT STANDARDS ( $\mu\text{g/l}$ )	PAL ( $\mu\text{g/l}$ )	ENFORCEMENT STANDARDS ( $\mu\text{g/l}$ )	PAL ( $\mu\text{g/l}$ )
UNOP	di-n-octyl phthalate	-	-	-	-	-	-	-	-	-	-
241NT	2,4-dinitrotoluene	-	-	0.11	9.1	330/230 (5)	-	0.05	0.005	-	-
26DNT	2,6-dinitrotoluene	-	-	-	-	-	-	0.05	0.005	-	-
1ANT	fluoranthene	-	-	42	54	3,980/- (5)	40/16 (5)	-	-	-	-
1E	iron	300 (1)	-	300	-	- / 1	-	300 (7)	150 (7)	-	-
HARD	hardness	-	-	-	-	-	-	-	-	-	-
HG	mercury	2	2	0.144	0.146	2.4/0.012	2.1/0.025	2	0.2	-	-
MEDCH5	toluene	1,000	1,000	14,300	424,000	17,500/- (5)	6,300/5000 (5)	343	68.6	40 (8)	20 (8)
MEK	2-butanone	-	-	-	-	-	-	460	90	-	-
MN	manganese	50 (1)	200 (4)	50	100	-	-	50 (7)	25 (7)	-	-
2-MNAP	2-methylnaphthalene	-	-	-	-	-	-	-	-	-	-
NA	sodium	(9)	-	-	-	-	-	-	-	-	-
2-NANIL	2-nitroaniline	-	-	-	-	-	-	-	-	-	-
3-NANIL	3-nitroaniline	-	-	-	-	-	-	-	-	-	-
4-NANIL	4-nitroaniline	-	-	-	-	-	-	-	-	-	-
NAP	naphthalene	-	-	-	-	2,300/620 (5)	2,350/-	40	8	-	-
NB	nitrobenzene	-	-	19,800	-	27,000/- (5)	5,680/- (5)	-	-	-	-
NG	nitroglycerine	-	-	-	-	-	-	-	-	-	-

039213 T3/12



continued

TABLE 3-4  
GROUNDWATER CHEMICAL SPECIFIC STANDARDS AND GUIDANCE  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITIONS PLANT

CHEMICAL		SAFE DRINKING WATER ACT (SDWA) (d)		CWA WATER QUALITY CRITERIA (c)				WI PUBLIC HEALTH GROUNDWATER QUALITY STANDARDS (b)			
				FOR PROTECTION OF HUMAN HEALTH		FOR PROTECTION OF AQUATIC LIFE					
CHEMICAL CODE	CHEMICAL NAME	MCL ( $\mu\text{g/l}$ ) (e)	MCLG ( $\mu\text{g/l}$ )	WATER AND FISH CONSUMPTION ( $\mu\text{g/l}$ )	FISH CONSUMPTION ONLY ( $\mu\text{g/l}$ )	FRESHWATER ACUTE/CHRONIC ( $\mu\text{g/l}$ )	MARINE ACUTE/CHRONIC ( $\mu\text{g/l}$ )	CURRENT STANDARDS		PROPOSED STANDARDS	
								ENFORCEMENT STANDARDS ( $\mu\text{g/l}$ )	PAL ( $\mu\text{g/l}$ )	ENFORCEMENT STANDARDS ( $\mu\text{g/l}$ )	PAL ( $\mu\text{g/l}$ )
Ni	nickel	100	100	13.4	100	1,400/160 (10)	75/8.3	-	-	-	-
NIT	nitrite/nitrate- nonspecific	10,000 (11)	10,000 (11)	-	-	-/-	-/-	10,000	2,000	-	-
NDPA	n-nitrosodiphenylamine	-	-	(12)	(12)	-/-	-/-	-	-	-	-
NO2	nitrite	1,000	1,000	-	-	-/-	-/-	-	-	1000	200
NO3	nitrate	10,000	10,000	10,000	-	-/-	-/-	-	-	10,000	2,000
PB	lead	TT (3)	0	50	-	83/3.2 (10)	220/8.5	50	5	15	1.5
SE	selenium	50	50	10	-	0.02/0.005	0.3/0.071	10	1	50	10
SO4	sulfate	250,000 (1) 400/500 (4)	400/500 (4)	-	-	-/-	-/-	250,000 (7)	125,000 (7)	-	-
111TCE	1,1,1-trichloroethane	200	200	18400	1,030,000	-/-	31,200/- (5)	200	40	-	-
112TCE	1,1,2-trichloroethane	5	3	0.6	41.8	-9,400 (5)	-/-	0.6	0.06	-	-
TDS	total dissolved solids	500,000 (14)	-	-	-	-/-	-/-	-	-	-	-
236TMN	2,3,6-trimethylnaphthalene	-	-	-	-	-/-	-/-	-	-	-	-
TRCLE	trichloroethylene	5	0	2.7	80.7	45,000/21,000 (5)	2,000/- (5)	5	0.18	-	0.5



continued

TABLE 3-4  
GROUNDWATER CHEMICAL SPECIFIC STANDARDS AND GUIDANCE  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITIONS PLANT

CHEMICAL CODE	CHEMICAL NAME	SAFE DRINKING WATER ACT (SDWA) (d)		CWA WATER QUALITY CRITERIA (c)			WI PUBLIC HEALTH GROUNDWATER QUALITY STANDARDS (b)			
		MCL (µg/l) (a)	MCLG (µg/l)	FOR PROTECTION OF HUMAN HEALTH		MARINE ACUTE/CHRONIC (µg/l)	CURRENT STANDARDS ENFORCEMENT (µg/l)	CURRENT STANDARDS PAL (µg/l)	PROPOSED STANDARDS ENFORCEMENT (µg/l)	PROPOSED STANDARDS PAL (µg/l)
				WATER AND FISH CONSUMPTION (µg/l)	FISH CONSUMPTION ONLY (µg/l)					
ZN	Zinc	5000 (1)				102/110 (10)	5,000 (7)	2,500 (7)		

Sources:

- (a) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards", Office of Water, Washington, D.C. August, 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards", Office of Water, Washington, D.C. September, 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations: Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule", 57FR31776, July 17, 1992.  
(b) Wisconsin Administrative Code, Chapter NR 140.10, Table 1.

Notes:

- (1) Secondary drinking water standards, suggested level  
(2) Criteria are pH dependent. Refer to 53FR33178.  
(3) MCL for arsenic currently under review.  
(4) Proposed value.  
(5) Insufficient data to develop criteria. Value presented is the lowest observed effect level.  
(6) Standard indicated is propose value for total trihalomethanes (i.e., chloroform, dibromomethane, bromodichloromethane, and bromoform).  
(7) Values are for protection of public welfare (usually aesthetic concerns) rather than for protection of public health. Public welfare standards may not be enforced as rigorously as public health standards.

- (c) EPA, 1991, "Water Quality Criteria Summary", Office of Science and Technology, Health and Ecological Criteria Division, Ecological Risk Assessment Branch, Human Risk Assessment Branch, Washington, D.C. May 1, 1991.  
(d) EPA SDWA National Primary Drinking Water Regulations per 40 CFR 141: MCLs and MCLGs.

- (e) WDNR proposes to delete toluene from regulation as a public health water quality standard and to promulgate a public welfare water quality standard.  
(9) No MCL has been set for sodium. However, a reporting level of 20,000 µg/l has been established as the reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.  
(10) Hardness dependent criteria (100 mg/l CaCO<sub>3</sub> used).  
(11) Standard indicated is for total nitrite/nitrate.  
(12) Although no published criteria exist, values for NNDPA have been calculated using IRIS. Refer to Source (c).  
(13) Treatment technique requirement in effect.  
(14) The Preventative Action Limit for total dissolved solids (TDS) is 200,000 µg/l above an established background concentration; there is no Enforcement Standard for TDS.

Acronyms:

- CWA Clean Water Act  
EPA United States Environmental Protection Agency  
IRIS Integrated Risk Information System  
MCL Maximum Contaminant Level  
MCLG Maximum Contaminant Level Goal  
µg/l micrograms per liter, equivalent to parts per billion  
mg/l milligrams per liter, equivalent to parts per million  
PAL Preventative Action Limit  
SDWA Safe Water Drinking Act  
TDS Total Dissolved Solids  
WDNR Wisconsin Department of Natural Resources



**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES</b>			
<b>OTHER RESPONSE ACTIVITIES</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
All Hazardous Waste TSD Units	RCRA, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; (40 CFR Part 264)	Establishes minimum national standards which define the acceptable management of hazardous wastes for owners and operators of facilities which treat, store or dispose of hazardous wastes.	Should remedial actions involve management of RCRA wastes at an off-site TSD or if a treatment facility is constructed on-site, these requirements would be applicable.
	RCRA, General Facility Standards; (40 CFR Subpart B, 264.10-264.18)	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Should remedial actions involve management of RCRA wastes at an off-site TSD or if a treatment facility is constructed on-site, these requirements would be applicable.
	RCRA, Preparedness and Prevention; (40 CFR Subpart C, 264.30-264.37)	This regulation outlines requirements for safety equipment and spill-control for hazardous waste facilities. Facilities must be designed, maintained, constructed, and operated to minimize the possibility of an unplanned release that could threaten human health or the environment.	Safety and communication equipment should be incorporated into all aspects of the remedial process and local authorities should be familiarized with site operations.
	RCRA, Contingency Plan and Emergency Procedures; (40 CFR Subpart D, 264.30-264.37)	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	These requirements are relevant and appropriate for remedial actions involving the management of hazardous waste.



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARARs COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES</b>			
<b>OTHER RESPONSE ACTIVITIES</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
	RCRA, Releases from Solid Waste Management Units; (Subpart F, 264.90-264.109)	The scope of the regulation encompasses: groundwater protection standards; concentration limits; point of compliance; compliance period; requirements for groundwater monitoring, detection monitoring, and compliance monitoring; and the corrective action program. Provides guidelines for the remediation of solid waste management units including: establishes specific groundwater monitoring requirements, sets MCLs as level of compliance for upper aquifer, and establishes requirements of the corrective action program.	Applicable to remedial alternatives that involve the closure and post-closure of SWMUs because BAAP holds a RCRA Part B Permit.
	RCRA, Hazardous Waste Permit Program; (40 CFR Part 270)	Establishes provisions covering basic EPA permitting requirements.	RCRA permitting requirements need to be determined on a case-by-case basis, working with all involved regulatory agencies. However, any activity involving the treatment or containment of hazardous waste is subject to these permitting requirements.
Hazardous Waste Transportation	DOT Rule for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-172.558)	Outlines procedures for the packaging, labeling, manifesting, and transportation of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous wastes from the site.



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL REQUIREMENTS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES			
OTHER RESPONSE ACTIVITIES	CITATION	REQUIREMENTS	CONSIDERATIONS
Control of Air Emissions	Standards Applicable to Transporter of Hazardous Waste, RCRA Section 3003, 40 CFR 170 - 179.	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Requires a manifest, recordkeeping, and immediate action in the event of a discharge of hazardous waste.	This regulations will be applicable to any company contracted to transport hazardous material from the site.
	CAA - New Source Performance Standards; 40 CFR 60	Establish emission limits for a number of different pollutants for certain classes of new stationary sources. Include limits for fluorides, sulfuric acid mist, and total reduced sulfur.	These provisions are generally not applicable to cleanup actions. However, if a facility is a new source subject to a NSPS (such as an incinerator), the requirement may be applicable. If the pollutants emitted and the technology employed is similar to the pollutant and source category regulated, the NSPS may be considered relevant and appropriate.
	WDNR, General and Portable Sources Air Pollution Control Rules; Ambient Air Quality Standards (WAC, Chapter NR 404)	Primary and secondary ambient air quality standards for sulfur oxides, suspended particulates, carbon monoxide, ozone, nitrogen dioxide, lead, and particulate matter are established in this rule. The primary air standard provides protection for the public health with a margin of safety. The secondary air standard is the level of air quality that may be necessary to protect public welfare from unknown or anticipated adverse effects.	Potential applicable requirements for off-site TSD units. Potential Relevant and appropriate requirements for on-site TSD units.



**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES</b>			
<b>OTHER RESPONSE ACTIVITIES</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
	WDNR, Wisconsin Particulate and Sulfur Emissions Rules, Control of Particulate Emissions (WAC, Chapter NR 415)	This rule requires that precautions be taken to prevent particulate matter from becoming airborne. Particulate emission limits for certain processes are specified, and a default value of 0.4 Lbs of particulate matter per 1,000 pounds of gas is established for any process not listed in Section 415.05. Particulate emission limits for fuel-burning equipment and incinerators are established.	Potential applicable requirements for off-site TSD units. Potential Relevant and appropriate requirements for on-site TSD units.
	WDNR, Organic Compound Emission Rules (WAC, Chapter NR 419)	The rule states that no more than 5.7 liters of any liquid volatile organic compound (VOC) waste or any liquid, semisolid, or solid material containing more than 5.7 liters of any VOC may not be disposed of in one day's time from a facility in a manner which would permit evaporation into the ambient air during ozone season. The quantity of VOCs that evaporate into the ambient air during the ozone season must not exceed 15% (by weight) or 5.7 liters in any one day, whichever is larger.	Potential applicable requirements for off-site TSD units. Potential Relevant and appropriate requirements for on-site TSD units.
	WDNR, Wisconsin Carbon, Lead, and Nitrogen Emission Rules (WAC, Chapters 426-428)	These rules establish emission rules for carbon, lead, and nitrogen.	Potential applicable requirements for off-site TSD units. Potential Relevant and appropriate requirements for on-site TSD units.



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC ARARs COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARs COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES			
OTHER RESPONSE ACTIVITIES	CITATION	REQUIREMENTS	CONSIDERATIONS
Excavation	WDNR, Hazardous Air Pollutants Emissions Standards (WAC, Chapter NR 445)	Establishes acceptable emission rates for hazardous air contaminants, which are defined as contaminants for which no ambient air quality standard is set in Chapter NR 404 and which may cause or significantly contribute to mortality or a serious irreversible illness, or may pose a significant threat or public health or the environment.	Potential applicable requirements for off-site TSD units. Potential Relevant and appropriate requirements for on-site TSD units.
	CAA - NAAQS for Total Suspended Solids (40 CFR 129.105, 750).	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 260 $\mu\text{g}/\text{m}^3$ (primary standard).	Proper dust suppression methods must be implemented.
	CAA - NAAQS (40 CFR 50)	Provides Air Quality Standards for particulate matter and lead.	Fugitive dust emissions must be controlled during construction to maintain concentrations below these levels.
	RCRA - 40 CFR 264	Requires owner/operator to control wind dispersal of particulate matter.	Same as above.



TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES			
OTHER RESPONSE ACTIVITIES	CITATION	REQUIREMENTS	CONSIDERATIONS
	WDNR, General and Portable Sources Air Pollution Control Rules; Ambient Air Quality Standards (WAC, Chapter NR 404)	Primary and secondary ambient air quality standards for sulfur oxides, suspended particulated, carbon monoxide, ozone, nitrogen dioxide, lead, and particulate matter are established in this rule. The primary air standard provides protection for the public health with a margin of safety. The secondary air standard is the level of air quality that may be necessary to protect public welfare from unknown or anticipated adverse effects.	Same as above
	WDNR, Wisconsin Particulate and Sulfur Emissions Rules, Control of Particulate Emissions (WAC, Chapter NR 415)	This rule requires that precautions be taken to prevent particulate matter from becoming airborne. Particulate emission limits for certain processes are specified, and a default value of 0.4 Lbs of particulate matter per 1,000 pounds of gas is established for any process not listed in Section 415.05. Particulate emission limits for fuel-burning equipment and incinerators are established.	Same as above.



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARAARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES</b>			
<b>OTHER RESPONSE ACTIVITIES</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
	WDNR, Organic Compound Emission Rules (WAC, Chapter NR 419)	The rule states that no more than 5.7 liters of any liquid volatile organic compound (VOC) waste or any liquid, semisolid, or solid material containing more than 5.7 liters of any VOC may not be disposed of in one day's time from a facility in a manner which would permit evaporation into the ambient air during ozone season. The quantity of VOCs that evaporate into the ambient air during the ozone season must not exceed 15% (by weight) or 5.7 liters in any one day, whichever is larger.	Same as above.
	WDNR, Wisconsin Carbon, Lead, and Nitrogen Emission Rules (WAC, Chapters 426-428)	These rules establish emission rules for carbon, lead, and nitrogen. Same as above.	
	WDNR, Hazardous Air Pollutants Emissions Standards (WAC, Chapter NR 445)	Establishes acceptable emission rates for hazardous air contaminants, which are defined as contaminants for which no ambient air quality standard is set in Chapter NR 404 and which may cause or significantly contribute to mortality or a serious irreversible illness, or may pose a significant threat or public health or the environment.	Same as above.



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARARS COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES</b>			
<b>OTHER RESPONSE ACTIVITIES</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
Land Disposal	RCRA, Land Disposal Restrictions; (40 CFR Part 268)	Land disposal of RCRA hazardous wastes without prior treatment is prohibited. Waste at specific sites must be evaluated as to whether it meets the definition of one of the specified restricted wastes and the remedial action must constitute "placement" for the land disposal restrictions to be considered applicable. For each hazardous waste, the LDRs specify that the waste must be treated either by a treatment technology or to a concentration level prior to disposal in a RCRA Subtitle C permitted facility.	Under the LDRs, treatment standards have been established for all <u>listed</u> wastes. If it is determined that hazardous wastes at BAAP are subject to LDRs, these requirements will be potential relevant and appropriate requirements for on-site disposal and applicable requirements for off-site disposal.
	RCRA, Identification and Listing of Hazardous Waste; (40 CFR Part 261, 261.1-261.33)	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265.	Applicability of RCRA regulations to wastes found at the site is dependent on the solid waste meeting one of the following criteria: a. Generated through a RCRA listed source process. b. RCRA listed waste from non-specific source. c. Characteristically hazardous due to ignitability, corrosivity, reactivity, or toxicity.



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARs COMMON TO A VARIETY OF REMEDIAL ALTERNATIVES			
OTHER RESPONSE ACTIVITIES	CITATION	REQUIREMENTS	CONSIDERATIONS
Worker Protection	Occupational Health and Safety Act (OSHA), Health and Safety Standards; (29 CFR Part 1926)	This regulation specifies the type of safety training, equipment, and procedures to be followed during site investigation and remediation.	All phases of the remedial response project at BAAP should be executed in compliance with this regulation.
	OSHA, General Industry Standards; (29 CFR Part 1910)	Regulates worker health and safety at hazardous waste sites (i.e., specifies 8-hour time-weighted average concentration for various organics compounds). Training requirements for workers at hazardous waste operations are specified in 29 CFR Part 1910.120.	Under 40 CFR 300.38, requirements of the Act apply to all response activities under the NCP. Proper respiratory equipment will be worn if it is impossible to maintain the work atmosphere below the specified concentration. Workers performing site work are required to have completed specific training requirements.
	OSHA, Recordkeeping, Reporting, and Related Regulations; (29 CFR Part 1904)	This regulation outlines the recordkeeping and reporting requirements to be followed during on-site remedial activities.	These requirements apply to all site contractors and subcontractors, and must be followed during all site work.



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>POTENTIAL ACTION-SPECIFIC ARARs FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES</b>				
<b>TECHNOLOGY</b>	<b>DESCRIPTION</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
Containment by Capping	Low-permeability cover is constructed over the site to provide a barrier to water infiltration and/or prevent direct contact and ingestion hazards associated with contaminated soil surfaces.	RCRA, 40 CFR 264.117(c)	Restrict post-closure use of property as necessary to prevent damage to the cover.	Because capping would not include placement of hazardous waste into another unit, this requirement is a potential applicable ARAR. Where "placement" occurs, the requirement is potentially relevant and appropriate.
		WNDR, Hazardous Waste Disposal Landfill Cap Standards; Chapter 660.15.	Specification for a final cover for hazardous waste landfills or surface impoundments which have operated without an operating license are established in this chapter.	These requirements are potential relevant and appropriate requirements for a capping system.
Excavation and Disposal in On-Site Landfill	Excavate and dispose soils which are not regulated by RCRA LDRs in a secure on-site landfill constructed for that purpose.	RCRA, Landfills; (Subpart N, 264.300-261.339)	This regulation details the design, operation, monitoring, inspection, recordkeeping, closure, and permit requirements for a RCRA landfill.	For on-site disposal, these regulations are relevant and appropriate in order to ensure adequate long-term land-based management of hazardous materials. For containment oriented alternatives, the construction of caps using RCRA design and performance standards criteria may be warranted.



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Excavation and Disposal in Off-Site Landfill	Excavate and haul soil not regulated by LDRs to a secure, existing landfill.	Wisconsin Hazardous Waste Landfill Standards: Landfill and Surface Impoundment Standards (WDNR, Chapter NR 660)	This chapter establishes the requirements for initial site inspection and report, feasibility report, plan of operation, and minimum design requirements for landfills and surface impoundments.	This chapter applies to owners and operators of facilities that treat, store, or dispose of hazardous waste in landfills or surface impoundments.
		Also, see all requirements listed under "Excavation", and "All Hazardous Waste TSD Units".		
		RCRA, Landfills; (Subpart N, 264.301)	This regulation details the design, operation, monitoring, inspection, recordkeeping, closure, and permit requirements for a RCRA landfill.	For off-site disposal, these regulations are applicable requirements for the owners or operators of a Subtitle C landfill.
Excavation and Treatment by On-Site Incineration	Excavate and treat soil by a mobile incinerator which thermally destroys organics in a direct fired treatment unit.	Chapter NR 660; Wisconsin Hazardous Waste Landfill and Surface Impoundment Standards	This chapter establishes the requirements for initial site inspection and report, feasibility report, plan of operation, and minimum design requirements for landfills and surface impoundments.	This chapter applies to owners and operators of facilities that treat, store, or dispose of hazardous waste in landfills or surface impoundments.
		Also, see all regulations listed under "Excavation" and "Hazardous Waste Transportation".		
		RCRA, Incinerators; (Subpart O, 264.340-264.599)	This regulation specifies the performance standards, operating requirements and monitoring, inspection, and closure guidelines of any incinerator burning hazardous waste.	These substantive requirements established by this rule are potentially relevant and appropriate for on-site incineration of RCRA-regulated wastes.



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC ARARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Excavation and Treatment by Off-site Incineration	Excavate and treat soil by an incinerator which thermally destroys organics in a direct fired treatment unit.	Chapter NR 665; Wisconsin Hazardous Waste Incinerator Standards	This chapter establishes requirements and standards for incinerators that burn hazardous wastes. Requirements for design of the Incinerator are outlined in Section NR640.06.	The substantive requirements of this rule are potentially relevant and appropriate for on-site incineration of RCRA-regulated wastes.
		Also, see requirements listed under "Excavation" and "Air Emissions".		
		RCRA, Incinerators; (Subpart O, 264.340-264.599)	This regulation specifies the performance standards, operating requirements and monitoring, inspection, and closure guidelines of any incinerator burning hazardous waste.	These requirements are potential applicable or relevant and appropriate requirements for off-site incineration of RCRA-regulated wastes.
		Chapter NR 665; Wisconsin Hazardous Waste Incinerator Standards	This chapter establishes requirements and standards for incinerators that burn hazardous wastes. Requirements for design of the Incinerator are outlined in Section NR640.06.	The substantive requirements of this rule are potentially applicable or relevant and appropriate requirements for off-site incineration of RCRA-regulated wastes.
See requirements listed under "Excavation", "Air Emissions", and "Hazardous Waste Transportation"				



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC ARARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES			
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS CONSIDERATIONS
Excavation and Treatment by Solvent Extraction	Excavate and mix soils with a chemical solvent in a mobile batch mixer. Soil settles out and solvent and contaminant is decanted off. The contaminant is then separated from the solvent to produce an effluent stream of concentrated contaminant.	See requirements listed under "Excavation" and "Hazardous Waste Transportation"	
Excavation and Treatment by Stabilization/Solidification	Soil is excavated and mixed with a setting agent to form a hard product in which contaminants are entrapped by the solidified mass.	See requirements listed under "Excavation" and "Hazardous Waste Transportation".	
Excavation and Treatment by Anaerobic Thermal Process	Soil is excavated and treated by a mobile unit which volatilizes/desorbs organic contaminants from the soil and condenses them into a liquid stream.	See requirements listed under "Excavation", "Hazardous Waste Transportation", and "Air Emissions".	



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APFARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

POTENTIAL ACTION-SPECIFIC APFARS FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Excavation and Treatment by Soil Washing	Excavate and mix soils with an aqueous-based washing solution in a series of high-energy mobile washing units. Organics and inorganics can be separated from soils with this system. Washing solution is recycled.	See requirements listed under "Excavation" and "Hazardous Waste Transportation".		
Excavation and Treatment by Soil Vitrification	Soils are excavated and heated to temperatures exceeding 2000° C. Organic and nitrate chemical components are destroyed, the remaining contaminants are immobilized into a geologically stable glass material, and the overall volume of the waste is reduced.			



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC ARARs FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Excavation and Treatment by Biodegradation/Composting	Soils contaminated by organics are excavated and treated with engineered (rather than naturally occurring) biological decomposition under controlled conditions.	See requirements listed under "Excavation" and "Hazardous Waste Transportation".		
Excavation and Treatment by Forced Aeration Through Soils	A soil pile in constructed on an elevated perforated base through which air is force into the pile.	RCRA, Waste Piles; (Subpart L, 264.250-264.269)	This regulation establishes procedures, operating requirements, and closure and post-closure for waste piles.	Should a remedial action involve the placement of hazardous wastes in waste piles, this regulation would be applicable. According to RCRA, waste piles used for treatment or storage of non-containerized accumulation of solid, non-flowing hazardous waste may comply with either the waste pile or landfill requirements. The temporary storage or treatment of hazardous waste on-site, therefore, should meet the requirements of one or the other subpart.
Also, see all regulations listed under "Excavation", "Hazardous Waste Transportation", and "Air Emissions"				



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

POTENTIAL ACTION-SPECIFIC ARARs FOR SOIL TREATMENT AND DISPOSAL TECHNOLOGIES			
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS CONSIDERATIONS
In-Situ Vacuum Extraction	A vacuum is applied to wells at the site to extract vapor from voids in the subsurface soil. The vapor is collected and either treated or released to the atmosphere.	See requirements under "Air Emissions".	
In-Situ Stabilization/ Solidification	A settling agent is placed with contaminated soil to form a monolithic product in which contaminants are entrapped by the solidified mass.	See requirements under "Air Emissions".	
In-Situ Bioventing	Air, nutrients, and moisture (as needed) are injected into a contaminated soil zone to enhance the indigenous microbe environment and increase the biodegradation rate of organic contaminants.	See requirements under "Air Emissions".	



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS			
TECHNOLOGY	DESCRIPTION	CITATION	CONSIDERATIONS
In-Situ Biodegradation/Composting	Soils contaminated by organics are treated in place with engineered (rather than naturally occurring) biological decomposition under controlled conditions.	See requirements under "Air Emissions".	
In-Situ Vitrification	Soils are heated in place to temperatures exceeding 2000°C. Organic and nitrate chemical components are destroyed, the remaining contaminants are immobilized into a geologically stable glass material, and the overall volume of the waste is reduced.	See requirements under "Air Emissions".	
In-Situ Forced Aeration through Soil Piles	Air is forced into an existing soil pile to enhance biodegradation of organic contaminants.	See requirements under "Air Emissions".	



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>ACTION-SPECIFIC ARARs FOR WATER TREATMENT AND DISPOSAL TECHNOLOGIES</b>				
<b>TECHNOLOGY</b>	<b>DESCRIPTION</b>	<b>CITATION</b>	<b>REQUIREMENTS</b>	<b>CONSIDERATIONS</b>
Containment with Slurry Wall	Emplacement of a low permeability barrier to restrict groundwater migration. Should include a cover system to reduce infiltration.	RCRA - Land Disposal Restriction (40 CFR Part 268)	See requirements under "Land Disposal Restrictions".	Excavation of soil for construction of slurry wall may trigger LDRs. Materials subject to LDRs must therefore be placed in another unit.
Collection of Water into Groundwater Extraction Wells	Installation of several strategically located pumping wells to collect contaminated groundwater for treatment.	WDNR, Wisconsin Well Construction Standards, (WAC, Chapter NR 112)	This rule establishes standards and approvals for well construction. Any withdrawal well or combination of wells withdrawing more than 70 gpm or more is subject to this rule.	Any remedial alternative considered during the FS which proposes pumping of groundwater at a rate of greater than or equal to 70 gpm will consider this rule as a possible ARAR.
Treatment with UV/Oxidation	Oxidize organic contaminants in extracted groundwater through simultaneous application of UV light and ozone or hydrogen peroxide.	See requirements under "Air Emissions".		
Treatment with Air Stripping	Reduce concentration of volatile organics through intimate contact of extracted groundwater with air. Water descends a packed column while air forced up the column to promote mass transfer of organics from aqueous to gaseous phase.	See requirements under "Air Emissions".		



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC ARARS FOR WATER TREATMENT AND DISPOSAL TECHNOLOGIES  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

ACTION-SPECIFIC ARARS FOR WATER TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Treatment with Carbon Adsorption	Reduce concentrations of aqueous or gaseous phase organics through adsorption onto granular activated carbon. May be used as a polishing strip for treatments such as air stripping to further reduce organic contaminant concentrations in groundwater or to capture organics in air stripper emissions. Process produces concentrated wastewater requiring further treatment.	See requirements under "Air Emissions".		
Treatment with Resin Adsorption	Contaminants are transferred from the dissolved state to the surface of the resin. Resin can be regenerated by removing the contaminants with solvent. Process produces a concentrated wastewater requiring further treatment.		No requirements identified.	
In Situ Biological Treatment	Introduce nutrients, oxygen, and methane into the groundwater using a matrix of extraction wells and recirculation techniques.		See requirements under "Air Emissions".	



continued

TABLE 3-5  
POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

ACTION-SPECIFIC ACTIONS FOR WATER TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Discharge into Off-Site Water Treatment Facility	Off-site disposal of extracted groundwater to a POTW. Groundwater would require transport by means of a force main and/or gravity feed sewer or by truck to the POTW.	CWA, National Pretreatment Standards; (40 CFR Part 403)	This regulation sets pretreatment standards for the introduction of pollutants from non-domestic sources into POTWs. These regulations are designed to control pollutants which pass through, cause interference, or are otherwise incompatible with treatment processes at a POTW.	If treated groundwater is discharged to a POTW, the discharge must meet all discharge limitations imposed by the POTW.
Also, see requirements listed under "Transportation".				
Discharge by Groundwater ReInjection	Groundwater is re-injected using a series of wells and pumps. Can be used to enhance plume removal and accelerate remediation.	SDWA - Underground Injection Control Regulations; (40 CFR Parts 144, 146, 147, 1000)	These regulations outline minimum program and performance standards for underground injection programs.	State regulations prohibit discharge of water by re-injection wells.
		WDNR, Wisconsin Well Construction Standards, (WAC, Chapter NR 112)	In addition to establishing standards and approvals for well construction, this regulation prohibits the use of injection wells of any sort.	Because the state requirement is an enforceable requirement and more stringent than the federal requirements, it takes precedence of the federal requirement for remedies using re-injection wells.



continued

**TABLE 3-5**  
**POTENTIAL ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ACTION-SPECIFIC ARARS FOR WATER TREATMENT AND DISPOSAL TECHNOLOGIES				
TECHNOLOGY	DESCRIPTION	CITATION	REQUIREMENTS	CONSIDERATIONS
Discharge to Surface Water	Discharge treated groundwater directly to nearby surface water body. Transport groundwater by means of force main.	Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES); (40 CFR Part 122, 125)	This rule requires permits specifying the permissible concentration or level of contaminants in the effluent for the discharge of pollutants from any point source into waters of the U.S.	Both on- and off-site discharges to surface waters are required to meet the requirements of the NPDES, including discharge limitations, monitoring requirements, and best management practices.

**Notes:**

TSD = treatment, storage, or disposal  
 RCRA = Resource Conservation and Recovery Act  
 TSDF = Treatment, Storage, and Disposal Facility  
 DOT = Department of Transportation  
 EPA = U.S. Environmental Protection Agency

SWMU = Solid Waste Management Act  
 CAA = Clean Air Act  
 WDNR = Wisconsin Department of Natural Resources  
 NAAQS = National Ambient Air Quality Standards  
 LDRs = Land Disposal Restrictions



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**TABLE 4-1**  
**EXPOSURE PATHWAYS -**  
**CURRENT AND FUTURE LAND USE**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

POTENTIAL EXPOSED POPULATION	EXPOSURE, ROUTE, MEDIUM AND EXPOSURE POINT	PATHWAY SELECTED FOR EVALUATION?	REASON FOR SELECTION OR EXCLUSION
Grounds Maintenance Workers	Dermal contact with, incidental ingestion and inhalation of chemicals in surface soil	Yes (current and future scenario)	Potential exists for workers to be exposed to chemicals in surface soil.
Research Workers	Dermal contact with and incidental ingestion of chemicals in surface soil	No	On site infrequently and not expected to visit contaminated areas.
Hunters	Dermal contact with and incidental ingestion of chemicals in surface soil	No	Magnitude of exposure less than that of grounds maintenance worker.
	Ingestion of chemicals in deer meat	No	Tissue analysis of deer meat indicates that it is not contaminated.
Farmer	Dermal contact with, incidental ingestion, and inhalation of chemicals in surface soil	Yes (future scenario)	Although no contaminated areas are currently used for crop farming, the potential exists for some areas to be farmed in the future.
	Ingestion of chemicals in beef	No	No cattle are currently grazed on contaminated soil. Physical characteristics of contaminated areas make them unlikely future pastures.
Construction Worker	Dermal contact with, incidental ingestion of, and inhalation of chemicals in surface and subsurface soils	Yes (future scenario)	Potential exists for future land use to involve excavation for foundations or utilities.
Residents	Dermal contact with and incidental ingestion of chemicals in surface soil	Yes (future scenario)	Although it is not a realistic future use, residential scenario is selected to provide a conservative comparison to other scenarios.



TABLE 4-2  
EQUATIONS USED TO ESTIMATE CHEMICAL INTAKE

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

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INGESTION OF SOIL OR SEDIMENT

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times RAF \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS	=	chemical concentration in soil (mg/kg)
IR	=	ingestion rate (mg soil/day)
RAF	=	relative absorption factor (unitless) <sup>1</sup>
CF	=	conversion factor (10 <sup>-6</sup> kg/mg)
FI	=	fraction ingested from site
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time - period over which exposure is averaged (days) <sup>2</sup>

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DERMAL CONTACT WITH SOIL OR SEDIMENT

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times AF \times SA \times RAF \times CF \times EF \times ED}{BW \times AT}$$

where:

CS	=	chemical concentration in soil (mg/kg)
AF	=	soil to skin adherence factor (mg/cm <sup>2</sup> )
SA	=	skin surface area exposed (cm <sup>2</sup> /event)
RAF	=	relative absorption factor (unitless) <sup>1</sup>
CF	=	conversion factor (10 <sup>-6</sup> kg/mg)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time - period over which exposure is averaged (days) <sup>2</sup>

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(continued)

**TABLE 4-2**  
**EQUATIONS USED TO ESTIMATE CHEMICAL INTAKE**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

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**INHALATION OF SUSPENDED PARTICULATES OR VOLATILES**

$$\text{Intake (mg/kg-day)} = \frac{CA \times RAF \times IHR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA	=	chemical concentration in air (mg/m <sup>3</sup> )
IHR	=	inhalation rate (m <sup>3</sup> /hour)
RAF	=	relative absorption factor (unitless) <sup>1</sup>
ET	=	exposure time (hours/events)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time - period over which exposure is averaged (days) <sup>2</sup>

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**INGESTION OF SURFACE WATER**

$$\text{Intake (mg/kg-day)} = \frac{CW \times RAF \times CR \times ET \times EF \times ED}{BW \times AT}$$

where:

CW	=	chemical concentration in water (mg/l)
CR	=	contact rate (L/hour)
RAF	=	relative absorption factor (unitless) <sup>1</sup>
ET	=	exposure time (hours/event)
EF	=	exposure frequency (events/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time - period over which exposure is averaged (days) <sup>2</sup>



(continued)

TABLE 4-2  
EQUATIONS USED TO ESTIMATE CHEMICAL INTAKE

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

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DERMAL CONTACT WITH SURFACE WATER

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

CW	=	chemical concentration in water (mg/l)
SA	=	skin surface area (cm <sup>2</sup> /event)
PC	=	chemical specific dermal permeability constant (cm/hr) <sup>3</sup>
ET	=	exposure time (hours/event)
EF	=	exposure frequency (events/year)
ED	=	exposure duration (years)
CF	=	conversion factor (1 liter/1000 cm <sup>3</sup> )
BW	=	body weight (kg)
AT	=	averaging time - period over which exposure is averaged (days) <sup>2</sup>

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Notes:

<sup>1</sup> RAF - Ingestion and Inhalation: Assumed to be 100%.

RAF - Dermal: Little data exist regarding the fraction of chemicals in soil that cross the skin. In the absence of this data, the dermal pathway will not be evaluated.

<sup>2</sup> AT: The averaging time is the pathway-specific period of exposure for noncarcinogenic effects (e.g., AT = ED x 365 days/year), and 70 year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year).

<sup>3</sup> PC: If chemical-specific PC value is not available, the permeability of water (1.5x10<sup>-3</sup>) is used as a default value.

Source: USEPA, 1989b



**TABLE 4-3**  
**EXPOSURE PARAMETERS -**  
**OCCUPATIONAL/RECREATIONAL CONTACT WITH SOIL AND SEDIMENT**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

PARAMETER	MAINTENANCE WORKER	CONSTRUCTION WORKER	FARMER	OLDER CHILD (6-16)	UNITS	SOURCE
Soil Ingestion Rate (IR)	100	480	480	100	mg/day	USEPA, 1991b
Inhalation Rate (IR)	2.5	2.5	1.7	NA	m <sup>3</sup> /hr	USEPA, 1990
Soil Adherence Factor (AF)	1.0	1.0	1.0	1.0	mg/cm <sup>2</sup>	USEPA, 1992a
Surface Area Exposed (SA) <sup>1</sup>	2,100	2,100	2,100	6,150	cm <sup>2</sup>	USEPA, 1990
Fraction Ingested from Site (FI)	100%	100%	100%	100%		Assumption
Exposure Time (ET)	8	8	1	NA	hours/day	Assumption
Exposure Frequency (EF) <sup>2</sup>	24	20	24	24	days/year	USEPA, 1991b/ Assumption
Exposure Duration (ED)	25	20 days	30	11	years	USEPA, 1991b/ Assumption
Body Weight (BW)	70	70	70	40	kg	USEPA, 1989b
Averaging Time (AT)						
Cancer	70	70	70	70	years	USEPA, 1991b/ Assumption
Noncancer	25	20 days	30	11	years	Assumption

**Notes:**

- <sup>1</sup> 2,100 cm<sup>2</sup> = 50th percentile value - hands and forearms  
6,150 cm<sup>2</sup> = 50th percentile value - hands, feet, arms, and legs
- <sup>2</sup> 24 days = 2 days/week for 12 weeks (summer season)  
20 days = 5 workdays/week for 4 weeks
- mg = milligram  
hr = hour  
cm<sup>2</sup> = square centimeter  
kg = kilogram  
m<sup>3</sup> = square meter  
NA = not applicable



**TABLE 4-4**  
**EXPOSURE PARAMETERS -**  
**FUTURE RESIDENTIAL SURFACE SOIL CONTACT**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

PARAMETER	CHILD 1-6	ADULT 7-30	UNITS	SOURCE
Soil Ingestion Rate (IR)	200	100	mg/day	USEPA, 1991b
Soil Adherence Factor (AF)	1.0	1.0	mg/cm <sup>2</sup>	USEPA, 1992a
Surface Area Exposed (SA) <sup>1</sup>	3,720	2,100	cm <sup>2</sup>	USEPA, 1990
Fraction Ingested from Site (FI)	100%	100%		Assumption
Exposure Frequency (EF)	350	350	days/year	USEPA, 1991b
Exposure Duration (ED)	6	24	years	USEPA, 1991b
Body Weight (BW)	15	70	kg	USEPA, 1989a/1991b
Averaging Time (AT)				
Cancer	70	70	years	USEPA, 1991b
Noncancer	6	24	years	USEPA, 1991b

**Notes:**

<sup>1</sup> Child: 50th percentile area - hands, feet, arms, and legs  
Adult: 50th percentile area - hands and forearms

mg = milligram  
cm<sup>2</sup> = square centimeter  
kg = kilogram



**TABLE 4-5**  
**RECREATIONAL CONTACT WITH SURFACE WATER**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

PARAMETER	OLDER CHILD (6-16)	UNITS	SOURCE
Contact Rate (CR)	0.05	L/hour	USEPA, 1991b
Surface Area Exposed - Swimming (SA <sub>s</sub> ) <sup>1</sup>	13,000	cm <sup>2</sup>	USEPA, 1990
Surface Area Exposed - Wading (SA <sub>w</sub> ) <sup>2</sup>	6,150	cm <sup>2</sup>	USEPA, 1990
Exposure Time (ET)	2.6	hrs/day	USEPA, 1989b
Exposure Frequency (EF) <sup>3</sup>	24	days/year	USEPA, 1989b
Exposure Duration (ED)	11	years	Assumption
Body Weight (BW)	40	kg	USEPA, 1990
Averaging Time (AT)			
Cancer	70	years	USEPA, 1991b
Noncancer	11	years	Assumption

**Notes:**

<sup>1</sup> 50th percentile - whole body

<sup>2</sup> 50th percentile - hands, feet, arms, and legs

<sup>3</sup> 2 days/week for 12 weeks (summer season)

L = liter

cm<sup>2</sup> = square centimeter

kg = kilogram

hrs = hours



TABLE 4-6  
ORAL DOSE-RESPONSE INFORMATION FOR NONCARCINOGENIC EFFECTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	CHRONIC ORAL		SUBCHRONIC ORAL		STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	ANIMAL	UNCERTAINTY FACTOR	SOURCE
	RD	(mg/kg-day)	RD	(mg/kg-day)						
111TCE	5E-02 W	5E-01	5E-01	5E-01	Oral		Hepatotoxicity	Guinea Pig	1,000	HEAST
13DNB	2E+00	4E+00	4E+00	4E+00	Gavage		Hepatotoxicity, decreased body weight	Rat	100	HEAST
24DNT	2E-03	ND ****	ND ****	ND ****	Feeding	High	Neurotoxicity, Heinz bodies and biliary tract hyperplasia	Dog	100 A	RIS
24DNT	ND	ND	ND	ND						RIS
24NAP	ND	ND	ND	ND						
24NAP	Not Listed									
3NT	1E-02	1E-01	1E-01	1E-01	Gavage		Spleen Lesions	Rat	10,000	HEAST
ACET	1E-01	1E+00	1E+00	1E+00	Gavage	Low	Increased liver and kidney weights, nephrotoxicity	Rat	1,000 H.A.S	RIS
AG	5E-03	5E-03	5E-03	5E-03	Therapeutic	Medium	Angina	Human	2 L	RIS
AL	ND	ND	ND	ND						HEAST
ANAPNE	5E-02	5E-01	5E-01	5E-01	Gavage	Low	Hepatotoxicity	Mouse	3,000 H.A.D	RIS
ANAPYL	ND	ND	ND	ND						RIS
AS	3E-04 P	3E-04	3E-04	3E-04	Oral-diet	Medium	Keratinosis and hyperpigmentation	Human	3 H	RIS
B2EHP	2E-02	2E-02	2E-02	2E-02	Oral-diet	Medium	Increased liver weight	Guinea Pig	1,000 H.A.S	RIS
BA	7E-02	7E-02	7E-02	7E-02	Oral-DW	Medium	Increased blood pressure	Human	3 H	RIS
BAANTR	ND	ND	ND	ND						RIS
BBFANT	ND	ND	ND	ND						RIS
BE	5E-03	5E-03	5E-03	5E-03	DW	Low	None observed	Rat	100 H.A	RIS
BGHPY	ND	ND	ND	ND						RIS
BRFANT	ND	ND	ND	ND						RIS
BR	Not Listed									RIS
CEH6	P									RIS
CCL3F	3E-01	7E-01	7E-01	7E-01	Gavage	Medium	Survival and histopathology	Rat	1,000 H.A.L	RIS
CCL4	7E-04	7E-03	7E-03	7E-03	Gavage	Medium	Liver lesions	Rat	1,000 H.A.S	RIS
CD (food)	1E-03	None	None	None	Oral-diet	High	Significant proteinuria	Human	10 H	RIS
LD (water)	5E-04	None	None	None	Oral-DW	High	Significant proteinuria	Human	10 H	RIS
CH2CL2	6E-02	6E-02	6E-02	6E-02	DW	Medium	Liver toxicity	Rat	100 H.A	RIS
CHCL3	1E-02	1E-02	1E-02	1E-02	Oral-diet	Medium	Fatty cyst formation in liver	Dog	1,000 H.A.S	RIS
CHRY	ND	ND	ND	ND						RIS
CL	Not Listed									
CR III	1E+00	1E+00	1E+00	1E+00	Oral-diet	Low	No effects observed	Rat	100 H.A, MF=10	RIS
CR VI	5E-03	2E-02	2E-02	2E-02	Oral-DW	Low	No effects reported	Rat	500 H.A.S	RIS
CU	ND	ND	ND	ND						RIS
DBA/HA	ND	ND	ND	ND						RIS
DBZ/FUR	Data inadequate for risk assessment									
DEP	8E-01	8E+00	8E+00	8E+00	Oral-diet	Low	Reduced terminal body weight	Rat	1,000 H.A.S	HEAST
DEHP	1E-01	1E+00	1E+00	1E+00	Oral-diet	Low	Increased mortality	Rat	1,000 H.A.S	RIS
DNOP	2E-02 R	2E-02	2E-02	2E-02	Oral-diet	Medium	Elevated SGOT, SGPT, liver & kidney weight	Rat	1,000	HEAST
DPA	2.5E-02	2.5E-02	2.5E-02	2.5E-02	Oral-diet	Medium	Decreased body weight gain, increased liver & kidney weight	Dog	100 H.A	RIS
Fluob	1E-01	1E+00	1E+00	1E+00	Oral-diet	Low	Liver and kidney toxicity	Rat	1,000 H.A.S	RIS



TABLE 4-8  
ORAL DOSE-RESPONSE INFORMATION FOR NONCARCINOGENIC EFFECTS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	CHRONIC ORAL RfD		SUBCHRONIC ORAL RfD		STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
	(mg/kg-day)	(mg/kg-day)	(mg/kg-day)	**						
FANT	4E-02	4E-01	4E-01		Gavage	Medium	Increased liver weights, hematologic changes	Mouse	3,000 H.A.S	RIS
FURENE	4E-02	4E-01	4E-01		Gavage	Low	Hematologic changes, decreased RBC	Mouse	3,000 H.A.S	RIS
HG	3E-04 P	3E-04	3E-04		Parenteral		Kidney effects	Rat	1,000	HEAST
ICDPYR	ND	ND	ND							
MECHS	2E-01	2E+00	2E+00		Gavage	Medium	Weight change in liver and kidneys	Rat	1,000 H.A.S	RIS
MBK	5E-02 W	5E-01	5E-01		Gavage		Liver and kidney effects	Rat	1,000	HEAST
MN	1E-01	1E-01	1E-01		Oral-diet	Medium	CNS effects	Human	1	RIS
NAP	4E-02 P	4E-02	4E-02		Gavage		Decreased body weight gain	Rat	10,000	HEAST
NC	Not Listed									
NG	Not Listed									
NH3	34 mg/L R	34 mg/L	34 mg/L		DW		Taste threshold	Human	none	RIS
NH4NO2	Not Listed									
NI	2E-02	2E-02	2E-02		Oral-diet	Medium	Decreased body and organ weights	Rat	100 H.A	RIS
NI (NO2)	1E-01	1E-01	1E-01		Epidemiologic	High	Early critical signs of methemoglobinemia	Human Infant	1	RIS
NI (NO3)	1.6E+00	ND	ND		Epidemiologic	High	Early critical signs of methemoglobinemia	Human Infant	1	RIS
NINDMA	ND	ND	ND							
NINDMA	ND	ND	ND							
NINDPA	ND	ND	ND							
NINDPA	ND	ND	ND							
PB	ND	ND	ND							
PIANTH	ND	ND	ND							
PIR	3E-02	3E-01	3E-01		Gavage	Low	Kidney effects, renal tubular pathology	Mouse	3,000 H.A.S	RIS
SE	5E-03	5E-03	5E-03		Epidemiologic	Medium	Clinical seborrhea	Human	3 H	RIS
SN	6E-1	6E-1	6E-1		Diet		Liver and kidney lesions	Rat	100	HEAST
SO4	Not Listed									
TCLEE	1E-02	1E-01	1E-01		Gavage	Medium	Hepatotoxicity	Mouse	1,000 H.A.S	RIS
TRGLE	P									
V	7E-03	7E-03	7E-03		Oral-DW		None observed	Rat	100	HEAST
XYLEN	2E+00	4E+00	4E+00		Gavage	Medium	Hyperactivity, decreased body weight	Rat	100 H.A	RIS
ZN	2E-01	2E-01	2E-01		Therapeutic		Anemia	Human	10	HEAST

ND - No data available  
 W - RID withdrawn from RIS  
 P - RID pending in RIS  
 N - No data in RIS  
 NE - Not evaluated by RIS  
 H - Under review by RIS  
 \*RID for naphthalene is used as surrogate for PAHs without assigned RID  
 \*\*All subchronic values are obtained from HEAST 1992  
 \*\*\*\* - Chronic RID used when no subchronic RID is available  
 Uncertainty factors - variation in human sensitivity  
 A - animal to human extrapolation  
 S - extrapolation from subchronic to chronic NOAEL  
 L - extrapolation from LOAEL to NOAEL  
 N - NOEL not attained  
 D - Lack of supporting data  
 Additional uncertainty factors or modifying factors (MF) of 1 to 10 may be added to account for other uncertainties such as inadequacies in the database or the severity of the effect

SOURCES:

IIRIS - Integrated Risk Information System files as of August 1992  
 HEAST - Health Effects Assessment Tables 1992



TABLE 4-7  
ORAL DOSE-RESPONSE INFORMATION FOR CARCINOGENIC EFFECTS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Compound	Weight of Evidence	Oral		Test Species	Study Type	Tumor Type	Source
		Slope Factor	[[mg/kg/day](-1)]				
111TCE	D						RIS
130MB	D						HEAST
24DNT	B2		0.8E-01 *	Rat	Diet	Liver, mammary gland	RIS
26DNT	B2		0.8E-01 *	Rat	Diet	Liver, mammary gland	RIS
26NAP	NE						RIS
26NDPA	Not Listed						
3NT	Not Listed						
ACET	D						RIS
AG	D						RIS
AL	Not Listed						
ANAPNE	NE						RIS
ANAPYL	D						RIS
AS	A		1.8E+00 **	Human	DW	Skin tumors	RIS
B2EHP	B2		1.4E-02	Mouse	Oral/Diet	Hepatocellular carcinoma	RIS
BA	NE						RIS
BAANTR	B2		ND ***				RIS
BAPYR	B2		7.3E+00	Mouse	Diet	Forestomach	RIS
BBFANT	B2		ND ***				RIS
BE	B2		4.3E+00	Rat	DW	Total tumors	RIS
BGHPY	D						RIS
BKGANT	B2		ND ***				RIS
BR	Not Listed						
CEH6	A		2.9E-02	Human	Occup	Leukemia	RIS
CCL3F	NE						RIS
CCL4	B2		1.3E-01	Several	Gavage	Liver	RIS
CD	B1		NA				RIS
CH2CL2	B2		7.5E-03	Mouse	DW	Hepatocellular	RIS
CHCL3	B2		6.1E-03	Rat	DW	Kidney	RIS
CHRY	B2		NA ***				RIS
CL	Not Listed						
CR III	NE						RIS
CR V	A		NA				RIS
CU	D						RIS
DEAHA	B2		ND ***				RIS
DB2FUR	D						RIS
DEP	D						RIS
DNEBP	D						RIS
DNOP	Not Listed						
DPA	ND						RIS
ETC6H5	D						RIS
FANT	D						RIS



TABLE 4-7  
ORAL DOSE-RESPONSE INFORMATION FOR CARCINOGENIC EFFECTS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Compound	Oral			Test Species	Study Type	Tumor Type	Source
	Weight of Evidence	Stimulus Factor [(mg/kg/d) <sup>2</sup> (-1)]					
FLUORENE	D						IRIS
HG	D						IRIS
ICDPYR	B2	ND	***				IRIS
MECHS	D						IRIS
MBK	NE						IRIS
MIN	D						IRIS
NAP	D						IRIS
NC	Not Listed						
NG	Not Listed						
NH3	Not Listed						
NH3N2	Not Listed						
NI	NE						IRIS
NIT (NO2)	P						IRIS
NIT (NO3)	P						IRIS
NNDMEA	B2	5.1E+01		Rat	DW	Liver	IRIS
NNDNPA	B2	7.0E+00		Rat	DW	Liver	IRIS
NNDPA	B2	4.0E-03		Rat	Diet	Urinary bladder	IRIS
PB	B2	ND					IRIS
PHANTR	D						IRIS
PYR	D						IRIS
SE	D						IRIS
SN	Not Listed						IRIS
SO4	Not Listed						
TCLEE	B2	5.1E-02 W.X		Mouse	Gavage	Liver tumors	HEAST 1991
TRICLE	B2	1.1E-02 W.X		Mouse	Gavage	Liver	HEAST 1991
V	ND						IRIS
XYLEN	D						IRIS
ZN	D						IRIS

Weight of Evidence: A - Human carcinogen  
B - Probable human carcinogen (B1 - limited evidence of carcinogenicity in humans;  
B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack  
of evidence in humans)  
C - Possible human carcinogen  
D - Not classifiable as to human carcinogenicity  
E - Evidence of lack of carcinogenicity to humans

\*Based on IRIS for 2,4-D, 2,6-dinitrotoluene  
\*\*Based on unit risk of 5E-5 ug/L in drinking water  
\*\*\* Slope factor for benzo(a)pyrene used as surrogate value

NA - Not Applicable  
ND - Not Determined  
NE - Not Evaluated by EPA  
W - Withdrawn from IRIS  
X - Withdrawn from HEAST 1992  
P - IRIS input pending  
R - Under review on IRIS  
DW - Drinking water

SOURCES:

IRIS - Integrated Risk Information System files as of August 1992  
HEAST - Health Effects Assessment Tables 1992 unless otherwise noted

UBAT007 MK1



TABLE 4-8  
 INHALATION DOSE-RESPONSE INFORMATION FOR CARCINOGENIC EFFECTS  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT

Compound	Weight of Evidence	Inhalation		Test Species	Study Type	Tumor Type	Source
		Slope Factor* [(mg/kg/day)(-1)]					
111TCE	D						RIS
13DMB	D						HEAST
24DNT	B2	ND					RIS
26DNT	B2	ND					RIS
2MINAP	NE						RIS
2NNDPA	Not Listed						
3NT	Not Listed						
ACET	D						RIS
AG	D						RIS
AL	Not Listed						
ANAPNE	NE						RIS
ANAPYL	D						RIS
AS	A	5.0E+01		Human	Inhalation	Respiratory tract	HEAST
B2EHP	B2	ND					RIS
BA	NE						RIS
BAAATR	B2	ND	**				RIS
BAPYR	B2	6.1E+00		Hamster	Inhalation	Respiratory Tract	HEAST
B8FANT	B2	ND	**				RIS
BE	B2	6.4E+00		Human	Occupational	Lung	HEAST
BGHIPY	D						RIS
BR	Not Listed						
C6H6	A	2.9E-02		Human	Occupational	Leukemia	HEAST
CCL3F	NE						RIS
CCL4	B2	5.3E-02		Several	Gavage	Liver	HEAST
CD	B1	6.1E+00		Human	Inhalation	Respiratory tract	HEAST
CH2CL2	B2	ND					RIS
CHCL3	B2	6.1E-02		Mouse	Gavage	Liver carcinoma	HEAST
CHRY	B2	ND	**				RIS
CL	Not Listed						
CR III	NE						RIS
CR VI	A	4.1E+01		Human	Occup	Lung	HEAST
CU	D						RIS
DBAHA	B2	ND	**				RIS
DBZFUR	D						RIS
DEP	D						RIS
DNBP	D						RIS
DNOP	Not Listed						
DPA	ND						RIS



TABLE 4-8  
 INHALATION DOSE-RESPONSE INFORMATION FOR CARCINOGENIC EFFECTS  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT

Compound	Weight of Evidence	Inhalation Slope Factor* [(mg/kg/day)/(-1)]	Test Species	Study Type	Tumor Type	Source
ETC6H5	D					IRIS
FANT	D					IRIS
FLURENE	D					IRIS
HG	D					IRIS
ICDPYR	B2	ND	**			IRIS
MEC6H5	D					IRIS
MBK	NE					IRIS
MN	D					IRIS
NAP	D					IRIS
NC	Not listed					
NG	Not listed					
NH3	Not listed					
NH3N2	Not listed					
NI	NE					IRIS
NIT (NO2)	P					IRIS
NIT (NO3)	P					IRIS
NNDMA	B2	5.1E+01	Rat	Oral-DW	Liver	HEAST
NNDNPA	B2	ND				IRIS
NNDPA	B2	ND				IRIS
P8	α2	ND				IRIS
PHANTR	D					IRIS
PYR	D					IRIS
SE	D					IRIS
SN	Not listed					
SO4	Not listed					
TCLEE	B2	ND				HEAST 1991
TRCLE	B2	1.7E-02 WX	Mouse	Inhalation	Lung	HEAST 1991
V	NE					IRIS
XYLEN	D					IRIS
ZN	D					IRIS
NA - Not Applicable	W - Withdrawn from IRIS					
ND - Not Determined	X - Withdrawn from HEAST, 1992					
NE - Not Evaluated by EPA	DW - Drinking Water					
	** - Cancer slope factor for BAP used for carcinogenic PAHs without assigned slope factors					
Sources:						
IRIS - Integrated Risk Information System files as of August 1992						
HEAST - Health Effects Assessment Tables 1992						
Weight of Evidence: A - Human carcinogen B - Probable human carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) C - Possible human carcinogen D - Not classifiable as to human carcinogenicity E - Evidence of lack of carcinogenicity to humans						
USAT008 WK1						



TABLE 4-9  
 INHALATION DOSE-RESPONSE INFORMATION FOR NONCARCINOGENIC EFFECTS  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT

COMPOUND	CHRONIC INHALATION RfC (mg/m <sup>3</sup> )	SUBCHRONIC INHALATION RfC (mg/m <sup>3</sup> )	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
11TCE	ND	ND						IRIS
13DNB	ND	ND						HEAST
24ONT	ND	ND						IRIS
26ONT	ND	ND						IRIS
26NAP	ND	ND						IRIS
26NAP	ND	NC						IRIS
26NDPA	Not Listed	Not Listed						IRIS
3NT	ND	ND						IRIS
ACET	ND	ND						IRIS
AG	ND	ND						IRIS
AL	Data inadequate for risk assessment							HEAST
ANAPNE	NE	NE						IRIS
ANAPYL	ND	ND						IRIS
AS	ND	ND						IRIS
BZHP	ND	ND						IRIS
BA	ND	ND						IRIS
BAANTR	ND	ND						IRIS
BBFANT	ND	ND						IRIS
BE	ND	ND						IRIS
BOHPY	ND	ND						IRIS
BR	Not Listed	Not Listed						IRIS
CRH6	ND	ND						IRIS
CCL3F	ND	ND						IRIS
CCL4	ND	ND						IRIS
CD	P	P						IRIS
CH2CL2	ND	ND						IRIS
CHCL3	ND	ND						IRIS
CHRY	ND	ND						IRIS
CL	Not Listed	Not Listed						IRIS
CR III	ND	R						IRIS
CR VI	ND	R						IRIS
CU	ND	ND						IRIS
DBAHA	ND	ND						IRIS
DBZFUR	ND	ND						IRIS
DEP	ND	ND						IRIS
DNJP	ND	ND						IRIS
DNOP	ND	ND						IRIS
DPA	ND	ND						IRIS
ETCH45	ND	ND						IRIS
FANT	ND	ND						IRIS



TABLE 4-0  
 INHALATION DOSE-RESPONSE INFORMATION FOR NONCARCINOGENIC EFFECTS  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT

COMPOUND	CHRONIC INHALATION NC (mg/m <sup>3</sup> )	SUBCHRONIC INHALATION NC (mg/m <sup>3</sup> )	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
FLUENE	ND	3.0E-04 P	Inhalation		Neurotoxicity	Human	50	HEAST
HQ	ND	ND						
ICDPYR	ND	ND						
MECHS	ND	4E-01 P	Inhalation	2E+00 P	CNS effects, eye and nose irritation	Human	500	HEAST
MIBK	ND	ND						IRIS
MIN	ND	ND						IRIS
NAP	ND	ND						HEAST
NC	Not listed	Not listed						
NS	Not listed	Not listed						
NH3	ND	ND						IRIS
NH3NH2	Not listed	Not listed						
NH	P	P						IRIS
NT (NO2)	ND	ND						IRIS
NT (NO2)	ND	ND						IRIS
NH2MEA	ND	ND						IRIS
NH2NPA	ND	ND						IRIS
NH2PA	ND	ND						IRIS
PS	ND	ND						IRIS
PHANTR	ND	ND						HEAST
PYR	ND	ND						IRIS
SE	ND	ND						IRIS
SN	ND	ND						HEAST
SO4	Not listed	Not listed						
TCLEE	ND	ND						IRIS
TRCLE	P	P						IRIS
V	ND	ND						HEAST
XYLEN	ND	ND						IRIS
ZN	ND	ND						IRIS

ND - No data available  
 W - RfD withdrawn from IRIS  
 P - RfD pending in IRIS  
 N - No data in IRIS  
 NE - Not evaluated by IRIS  
 R - Under review by IRIS  
 Sources  
 IRIS - Integrated Risk Information System files as of August 1992  
 HEAST - Health Effects Assessment Tables 1992

Uncertainty factors:  
 H - variation in human sensitivity  
 A - animal to human extrapolation  
 S - extrapolation from subchronic to chronic NOAEL  
 L - extrapolation from LOAEL to NOAEL  
 N - NOEL not attained  
 D - Lack of supporting data  
 Additional uncertainty factors or modifying factors (MF) of 1 to 10 may be added to account for other uncertainties such as inadequacies in the database or the severity of the effect

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**TABLE 4-10**  
**POTENTIAL SOURCES OF UNCERTAINTY FOR RISK ASSESSMENT**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

POTENTIAL SOURCE OF UNCERTAINTY	DIRECTION OF EFFECT	JUSTIFICATION
Likelihood of exposure pathways.	Overestimate	Pathways may not actually occur (e.g., future resident)
Use of maximum concentration and lack of consideration of degradation of chemicals.	Overestimate	Risk estimates are based on recent chemical concentrations. Concentrations will tend to decrease with time as a result of degradation processes.
Exposure assumptions (frequency, duration, and intensity).	Overestimate	Parameters selected are conservative estimates of exposure.
Lack of dermal absorption data to quantify dermal pathway for exposure to soil.	Underestimate	Dermal risk would be added to risk from ingestion and inhalation routes.
Extrapolation of animal toxicity data to humans.	Unknown, probably overestimate	Animals and humans differ with respect to absorption, metabolism, distribution, and excretion of chemicals. The magnitude and direction of the difference will vary with each chemical. Animal studies typically involve high-dose exposures, whereas humans are exposed to low doses in the environment.
Use of linearized, multi-stage model to derive cancer slope factors.	Overestimate	Model assumes a non-threshold, linear a. low dose relationship for carcinogens. Many compounds induce cancer by non-genotoxic mechanism. Model results in a 95% upper confidence limits of the cancer risk. The true risk is unlikely to be higher and may be as low as zero.
Summation of effects (cancer risks and hazard indices) from multiple substances.	Unknown	The assumption that effects are additive ignores potential synergistic and/or antagonistic effects. Assumes similarity in mechanism of action, which is not the case for many substances. Compounds may induce tumors or other toxic effects in different organs or systems.
Use of uncertainty factors in the derivation of reference doses.	Unknown	Ten-fold uncertainty factors are incorporated to account for various sources of uncertainty (animal-to-human extrapolation, protection of sensitive human populations, extrapolation from subchronic to chronic data, and use of LOAELs rather than NOAELs). Although some data seem to support the ten-fold factor, its selection is somewhat arbitrary.



TABLE 4-10  
POTENTIAL SOURCES OF UNCERTAINTY FOR RISK ASSESSMENT

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

POTENTIAL SOURCE OF UNCERTAINTY	DIRECTION OF EFFECT	JUSTIFICATION
Lack of toxicity values for many compounds to quantify inhalation pathway for exposure to soil.	Underestimate	Risks from additional compounds would be added to currently quantified risks from inhalation exposure.

Notes:

LOAEL = Lowest Observed Adverse Effect Level  
NOAEL = No Observed Adverse Effect Level



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TABLE 5-1  
PRIMARY ROUTES OF EXPOSURE FOR ECOLOGICAL RECEPTORS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

MEDIUM	ROUTE OF EXPOSURE	POPULATIONS EXPOSED
Surface Soil	Incidental ingestion of contaminated soil	Birds, mammals, and reptiles
	Dermal uptake	Amphibians and young, hairless mammals
Surface Water	Indirect exposures associated with the consumption of contaminated prey items	Seed-eating birds and mammals, and predatory and omnivorous mammals, birds, reptiles, and fish
	Ingestion of contaminated water	Birds, mammals, reptiles, amphibians, and fish
Sediment	Dermal contact with contaminated water	Fish, aquatic invertebrates, amphibians, and fish
	Indirect exposures associated with the consumption of contaminated prey items	Waterfowl, semi-aquatic mammals, reptiles, amphibians, and fish
	Ingestion of contaminated sediment	Fish, aquatic invertebrates
	Dermal contact with contaminated sediments	Fish, aquatic invertebrates
	Root uptake	Aquatic plants
Air	Indirect exposures associated with the consumption of contaminated prey items	Waterfowl, reptiles, amphibians, and semi-aquatic mammals
	Inhalation of volatile constituents and airborne particles	Birds, mammals, reptiles and amphibians



**TABLE 5-2**  
**SUMMARY OF EXPOSURE PATHWAYS EVALUATED IN THE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

STUDY AREA	MEDIUM			
	SURFACE SOIL	SURFACE WATER	SEDIMENT	AIR
Propellant Burning Ground	X			*
Landfill 1	NA	NA	NA	*
Final Creek	X			*
Settling Pond I	X			*
Settling Pond II	X			*
Settling Pond III	X			*
Settling Pond IV	X			*
Spoils Disposal Area I	X			*
Spoils Disposal Area II	X			*
Spoils Disposal Area III	X			*
Spoils Disposal Area IV	X			*
Spoils Disposal Area V	X			*
Deterrent Burning Ground	X			*
Existing Landfill	X			*
Rocket Paste Area	X	X	X	*
Nitroglycerine Pond	X	X	X	*
New Acid Area	NA	NA	NA	*
Oleum Plant and Oleum Plant Pond	X	X	X	*
Ballistics Pond		X	X	*
Old Acid Area	X			*
Old Fuel Oil Tank	NA	NA	NA	*

**Notes:**

na = no analytical data  
\* = pathway not evaluated



**TABLE 5-3**  
**REFERENCE TOXICITY VALUES FOR AQUATIC RECEPTORS - SURFACE WATER<sup>A</sup>**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

COMPOUND	RTV ( $\mu\text{g}/\text{l}$ )
<u>Surface Water</u>	
AL	748
AS	153
BA	1,360
BE	5.3
CL	94,300
CR	9.74
CU	2.27
FE	1,000
PB	3.2
MN	100
HG	0.012
NI	66.13
NIT	5,000
SO <sub>4</sub>	1,060,000
V	200
ZN	49.59
NH <sub>3</sub> N <sub>2</sub>	2,100

**Notes:**

<sup>A</sup> Summarized from information presented in Appendix Q, Table Q-3.  
 $\mu\text{g}/\text{l}$  = micrograms per liter



**TABLE 5-4**  
**REFERENCE TOXICITY VALUES FOR AQUATIC RECEPTORS - SEDIMENT<sup>A</sup>**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

COMPOUND	RTV ( $\mu\text{g/l}$ )
<u>Sediment</u>	
AL	<sup>B</sup>
NH3	75
CR	100
PB	50
HG	0.1
NIT	545
SO4	-
B2EHP	-
PHANTR	1,390
DEP	-
NG	-
NNDPA	-

**Notes:**

- <sup>A</sup> Summarized from information presented in Appendix Q, Table Q-3.  
<sup>B</sup> No RTVs available.



TABLE 5-5  
SUMMARY OF REFERENCE TOXICITY VALUES(a) FOR TERRESTRIAL RECEPTORS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICAL	INDICATOR SPECIES				
	Small Mammal	Small Bird	Herptile	Predatory Mammal	Predatory Bird
ACET	500	500	500	500	500
MEK	131	131	131	131	131
C6H6	10	10	10	10	10
CH2CL2	52.6	52.6	52.6	52.6	52.6
ANAPNE	350	350	350	350	350
ANAPYL	600	600	600	600	600
ANTRC	3300	3300	3300	3300	3300
B2EHP	19	19	19	19	19
BAANTR	2	2	2	2	2
BAPYR	0.002	0.002	0.002	0.002	0.002
BBFANT	40	40	40	40	40
BKFANT	72	72	72	72	72
CHRY	99	99	99	99	99
DBAHA	0.006	0.006	0.006	0.006	0.006
DNBP	600	600	600	600	600
DNOP	175	175	175	175	175
DEP	172	172	172	172	172
24DNT	40	40	40	1	40
DPA	31	31	31	25	31
NNDMEA	0.46	0.46	0.46	2.5	0.46
NNDPA	50	50	50	50	50
NNDNPA	5.1	5.1	5.1	5.1	5.1
FANT	40	40	40	40	40
FLRENE	250	250	250	250	250
ICDPYR	720	720	720	720	720
2MNAP	33	33	33	33	33
NAP	35.7	35.7	35.7	35.7	35.7
NC	9000	9000	9000	9000	9000
PHANTR	14	14	14	14	14
PYR	125	125	125	125	125
CCL3F	488	488	488	488	488
NG	31.5	31.5	31.5	3	31.5
AL	100	100	100	100	100
SB	0.35	0.35	0.35	0.35	0.35
AS	7.5	1	1	250	1
BA	1	1	1	1	1
BE	0.22	0.22	0.22	0.22	0.22
CD	0.32	7.6	7.6	0.32	7.6
CR	5.7	3.5	3.5	5.7	3.5
CU	1.21	0.2	0.2	1.21	0.2
PB	0.1	2.5	2.5	3	2.5
HG	0.12	0.007	0.007	0.1	0.007
NI	1.3	10.1	10.1	62.5	10.1
NO3	133	133	133	133	133
SE	0.004	0.06	0.06	0.004	0.06
AG	18.1	18.1	18.1	18.1	18.1
SO4	120	120	120	120	120
SN	0.1	3.5	3.5	0.1	3.5
ZN	160	160	160	160	160

(a) Ingestion toxicity data for chronic exposures by terrestrial organisms as summarized in Table N-3.



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**TABLE 6-1**  
**SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	PROGRAM ELEMENTS			
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING
Propellant Burning Ground	VOC-SST/MS, 135 collectors	--	25 new wells and 6 new piezometers; 116 samples from 25 new and 33 existing wells	9 borings, 112 analytical samples; 1 mud rotary boring, no analytical samples; 118 surface soil analytical samples
Landfill 1	--	GPR and TC	7 new wells; 14 samples from 7 new wells	2 soil borings, 10 analytical samples
Settling Ponds and Spoils Disposal Area	--	--	13 new wells; 58 samples from 13 new and 14 existing wells	1 soil boring, 6 analytical samples

**Notes:**

VOC-SST/MS = Volatile Organic Compounds - Surface Static Trapping/Mass Spectrometry  
GPR = Ground Penetrating Radar  
TC = Terrain Conductivity  
\* Includes 2 rounds of groundwater sampling



**TABLE 6-2**  
**SUMMARY OF BORINGS COMPLETED -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

BORING NUMBER	DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)	TOTAL NUMBER OF SPLIT-SPOON SAMPLES	NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS	PURPOSE
<u>Propellant Burning Ground</u>				
PBB-90-01 <sup>1</sup>	102	10	10	Borings were drilled at the 1949 Pit area to provide chemical data to characterize the type and vertical distribution of contaminants in the unsaturated soils below the 1949 Pit.
PBB-90-02 <sup>1</sup>	97	10	10	
PBB-91-01	107	21	12	
PBB-91-02	112	21	14	Borings were drilled at the former refuse pits to provide chemical data to characterize the type and vertical distribution of contaminants in the unsaturated soils below the former refuse pits.
PBB-91-03	101	22	14	
PBB-91-04	107	24	13	
PBB-91-05	111	25	12	Borings were drilled at the location of the former waste pits to provide chemical data to characterize the type and vertical distribution of contaminants in the unsaturated soils below the former waste pits.
PBB-91-06	111	21	14	
PBB-91-07	77	21	13	This boring was drilled at the Old Burn Area to provide chemical data to characterize the type and vertical distribution of contaminants in the unsaturated soils below the Old Burn Area.
PBB-89-10 <sup>2</sup>	260	26	0	This boring was drilled in the Propellant Burning Ground adjacent to PBB-89-10 to obtain split-spoon samples at 10-foot intervals throughout the entire unconsolidated thickness.
<u>Landfill 1</u>				
LOB-90-01	142	10	9	These borings were drilled at Landfill 1 to determine the nature and depth of waste materials and to characterize the vertical distribution of any contaminants leached from this site.
LOB-90-02	22	5	1	



continued

TABLE 6-2  
SUMMARY OF BORINGS COMPLETED -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

BORING NUMBER	DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)	TOTAL NUMBER OF SPLIT-SPOON SAMPLES	NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS	PURPOSE
Settling Ponds and Spoils Disposal Area SPB-01-01	67	10	6	This boring was drilled in the Settling Ponds and Spoils Disposal Area at Final Creek south of the wastewater treatment facility to assess whether use of the general purpose sewer and Final Creek to convey wastewater resulted in residual soil contamination in and below Final Creek.

Notes:

- 1 These borings drilled in the area of the 1949 Pit using dual-wall driven casing.
- 2 This boring is numbered out of sequence because it was drilled using mud rotary versus hollow-stem auger (HSA) drilling techniques and is adjacent to monitoring well cluster PBN-89-10.

ft = feet



**TABLE 6-3**  
**SUMMARY OF MONITORING WELLS AND PIEZOMETERS INSTALLED -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

<b>SITE AND WELL IDENTIFIER</b>	<b>DRILLING METHOD</b>	<b>BORING DEPTH FROM GROUND SURFACE (ft.)</b>	<b>BOTTOM ELEVATION OF SCREENS (ft. MSL)</b>	<b>LENGTH OF WELL SCREEN (ft.)</b>	<b>LOCATION</b>	<b>PURPOSE</b>
<b>Propellant Burning Ground</b>						
PBN-89-01 B -01 C -01 D	Dual-wall driven casing Dual-wall driven casing Dual-wall driven casing	195 210 240	711.33 676.06 635.05	5 5 5	Downgradient of Propellant Burning Ground	To provide horizontal and vertical definition to the plume.
PBN-89-02 B -02 C	Dual-wall driven casing Dual-wall driven casing	180 195	740.25 702.04	5 5	Downgradient of Propellant Burning Ground, east of PBN-85-01	To provide horizontal and vertical definition of the plume.
PBN-89-03 B -03 C	Dual-wall driven casing Dual-wall driven casing	128 160	722.80 684.87	5 5	Downgradient of Propellant Burning Ground, west of PBN-88-01	To provide horizontal and vertical definition of the plume.
PBN-89-04 B -04 C	Hollow-stem augers Dual-wall driven casing	150 190	713.23 671.70	5 5	Downgradient of Propellant Burning Ground, south of PBN-88-01	To provide horizontal and vertical definition of the plume.
PBM-89-05	Hollow-stem augers	95	757.58	20	Downgradient of Propellant Burning Ground	To provide horizontal and vertical definition of the plume.
PBM-89-06	Dual-wall driven casing	150	736.37	20	Downgradient of Propellant Burning Ground	To provide horizontal definition of the plume.
PBM-89-07	Hollow-stem augers	95	758.36	20	Downgradient of Propellant Burning Ground	To provide horizontal definition of the plume.
PBM-89-08	Hollow-stem augers	130	761.56	20	Downgradient of Propellant Burning Ground	To provide horizontal definition of the plume.



continued

**TABLE 6-3**  
**SUMMARY OF MONITORING WELLS AND PIEZOMETERS INSTALLED -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITE AND WELL IDENTIFIER</b>	<b>DRILLING METHOD</b>	<b>BORING DEPTH FROM GROUND SURFACE (ft.)</b>	<b>BOTTOM ELEVATION OF SCREENS (ft. MSL)</b>	<b>LENGTH OF WELL SCREEN (ft.)</b>	<b>LOCATION</b>	<b>PURPOSE</b>
PBM-89-09	Hollow-stem augers	125	760.48	20	Upgradient of Propellant Burning Ground	To provide horizontal definition of the plume near past unspecified activities.
PBN-89-10 A	Dual-wall driven casing	130	763.65	20	Downgradient of Decontamination	To provide horizontal and vertical definition of the plume throughout the unconsolidated thickness.
-10 B	Dual-wall driven casing	167	723.81	5	Oven and	
-10 C	Dual-wall driven casing	205	697.00	5	Contaminated	
-10 D	Dual-wall driven casing	255	645.25	5	Waste Area	
PBM-89-11	Hollow-stem augers	128	771.41	20	Upgradient of Propellant Burning Ground	To characterize water quality at the water table upgradient of the Propellant Burning Ground
PBN-89-12 A	Hollow-stem augers	106	753.66	20	Downgradient of Propellant Burning Ground	To provide horizontal and vertical definition of the plume.
-12 B	Dual-wall driven casing	140	714.04	5		
PBN-91-06 C	Dual-wall driven casing	220	645.3	10	Downgradient of Propellant Burning Ground	To provide horizontal and vertical plume definition.
-06 D	Dual-wall driven casing	251	594.8	10		
PBN-91-12 C	Dual-wall driven casing	200	668.8	10	Downgradient of Propellant Burning Ground	To provide horizontal and vertical plume definition.
-12 D	Dual-wall driven casing	231	620.2	10		
PBP-91-01 B	Dual-wall driven casing	253	704.3	10	Downgradient of Propellant Burning Ground	To provide vertical gradient data downgradient from Propellant Burning Ground.
-01 C	Dual-wall driven casing	253	658.3	10		
-01 D	Dual-wall driven casing	253	505.8	10		
PBP-91-02 B	Dual-wall driven casing	254	707.3	10	Downgradient of Propellant Burning Ground	To provide vertical gradient data downgradient from Propellant Burning Ground.
-02 C	Dual-wall driven casing	254	657.3	10		
-02 D	Dual-wall driven casing	254	595.8	10		



continued

TABLE 6-3  
SUMMARY OF MONITORING WELLS AND PIEZOMETERS INSTALLED -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
<u>Old Landfill</u>						
LOM-89-01	Dual-wall driven casing	159	761.86	20	Upgradient of Landfill 1	To provide background water quality data upgradient of Landfill 1
LON-89-02 A -02 B	Dual-wall driven casing Dual-wall driven casing	160 200	764.59 721.13	20 5	Downgradient of Landfill 1	To provide horizontal and vertical plume definition.
LON-89-03 A -03 B	Dual-wall driven casing Dual-wall driven casing	160 200	787.14 731.99	20 5	Downgradient of Landfill 1	To provide horizontal and vertical plume definition.
LOM-91-01	Dual-wall driven casing	151	765.8	10	Upgradient of Landfill 1	To provide background water quality data upgradient of Landfill 1.
LOM-91-02	Dual-wall driven casing	148	763.9	10	Upgradient of Landfill 1	To provide background water quality data upgradient of Landfill 1.
<u>Settling Ponds</u>						
SPN-89-01 C	Dual-wall driven casing	135	710.04	5	Downgradient of Final Creek, prior to entrance to Settling Pond 1	In association with existing wells S1101 and S1113, provide horizontal and vertical definition of the plume downgradient of Final Creek.
SPN-89-02 A -02 B -02 C	Hollow-stem augers Hollow-stem augers Dual-wall driven casing	74 105 140	751.67 823.53 691.60	20 5 5	Downgradient of Final Creek, prior to entrance to Settling Pond 1	To provide horizontal and vertical definition of the plume downgradient.
SPN-89-03 B -03 C	Hollow-stem augers Dual-wall driven casing	100 150	723.09 689.25	5 5	Downgradient of Final Creek, prior to entrance to Settling Pond 1	In association with existing well S1147, provide horizontal and vertical definition of the plume downgradient of the Final Creek.



continued

TABLE 8-3  
SUMMARY OF MONITORING WELLS AND PIEZOMETERS INSTALLED -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
SPN-89-04 B -04 C	Hollow-stem augers Hollow-stem augers	77	730.21	5	Downgradient of Final Creek and Settling Pond 1	In association with existing well S1148, provide horizontal and vertical definition of the plume downgradient of Final Creek.
		130	697.17	5		
SPN-89-05 A -05 B	Hollow-stem augers Dual-wall driven casing	60	754.25	20	Downgradient of Settling Ponds 2 and 3 and upgradient of Graf well	To provide horizontal and vertical definition of the plume downgradient of Settling Ponds 3 and 4 and upgradient of the Graf well.
		89	716.02	5		
SPN-91-02 D	Dual-wall driven casing	190	638.8	10	Downgradient of Final Creek and prior to entrance to Settling Pond 1	In association with existing nest SPN-89-02A,B,C, provide horizontal and vertical definition of the plume downgradient of Final Creek.
SPN-91-03 D	Dual-wall driven casing	202	616.2	10	Downgradient of Final Creek and prior to entrance to Settling Pond 1	In association with existing wells S1147, SPN-89-03B, C to provide horizontal and vertical definition of the plume downgradient of Final Creek.
SPN-91-04 D	Dual-wall driven casing	212	594.8	10	Downgradient of Final Creek and Settling Pond 1	In association with existing wells S1148, SPN-89-04B, C to provide horizontal and vertical definition of the plume downgradient of Final Creek.



**TABLE 6-4**  
**SUMMARY OF MONITORING WELLS LOGGED WITH BOREHOLE GEOPHYSICS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITE/WELL NO.</b>	<b>BORING DEPTH FROM TOP OF PVC RISER (feet)</b>	<b>APPROXIMATE DEPTH TO WATER FROM TOP OF PVC RISER (feet)</b>	<b>DATE LOGGED</b>	<b>DATE INSTALLED</b>	<b>DRILLING METHOD</b>
1. PBN-89-12B	142	89	5/12/89	4/15/89	Dual-wall driven casing
2. PBN-89-04C	183	90	5/12/89	4/16/89	Dual-wall driven casing
3. PBN-89-03C	162	87	5/12/89	3/9/89	Dual-wall driven casing
4. PBN-89-01D	241	102	5/12/89	1/20/89	Dual-wall driven casing
5. PBN-89-02C	195	126	5/12/89	3/19/89	Dual-wall driven casing
6. PBN-89-10D	240	111	5/12/89	3/7/89	Dual-wall driven casing
7. PBN-89-11	114	107	5/13/89	3/7/89	Hollow-stem augers
8. PBN-82-03C	117	75	5/13/89	3/15/82	Mud rotary
9. PBN-82-05C	134	105	5/13/89	3/11/82	Mud rotary
10. PBN-82-01C	141	108	5/13/89	3/10/82	Mud rotary
11. PBN-89-09	124	107	5/13/89	3/1/89	Hollow-stem augers
12. LON-89-02B	201	147	5/13/89	2/18/89	Dual-wall driven casing
13. LOM-89-01	158	142	5/13/89	2/17/89	Dual-wall driven casing
14. SPN-89-01C	121	65	5/15/89	3/29/89	Dual-wall driven casing
15. SPN-89-02C	132	57	5/15/89	4/14/89	Dual-wall driven casing
16. SPN-89-03C	131	52	5/15/89	4/13/89	Dual-wall driven casing
17. SPN-89-04C	107	38	5/15/89	3/30/89	Hollow-stem augers
18. SPN-89-05B	89	40	5/15/89	3/30/89	Dual-wall driven casing

**Notes:**

PVC = polyvinyl chloride



TABLE 6-5  
AQUIFER PUMPING TEST - SUMMARY OF DRAWDOWN AND RECOVERY ANALYSES  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

WELL/ PIEZOMETER	BOULTON DELAYED YIELD DRAWDOWN ANALYSES (1)			JACOB DRAWDOWN ANALYSES (2)			RESIDUAL DRAWDOWN ANALYSES	
	TRANSMISSIVITY (GPD/FT)	HYDRAULIC CONDUCTIVITY (CM/SEC)	STORATIVITY	TRANSMISSIVITY (GPD/FT)	HYDRAULIC CONDUCTIVITY (CM/SEC)	STORATIVITY	TRANSMISSIVITY (GPD/FT)	HYDRAULIC CONDUCTIVITY (CM/SEC)
PBP-91-01B	-	-	-	223,000	6.03E-02	0.07	239,000	6.46E-02
PBP-91-01C	214,000	5.78E-02	0.16	285,000	7.70E-02	0.08	236,000	6.38E-02
PBP-91-01D	235,000	6.35E-02	0.17	311,490	8.42E-02	0.11	257,000	6.95E-02
PBP-91-02B	261,000	7.05E-02	0.04	-	-	-	252,000	6.81E-02
PBP-91-02C	224,000	6.05E-02	0.07	-	-	-	259,000	6.97E-02
PBP-91-02D	314,000	8.49E-02	0.06	-	-	-	313,000	8.46E-02
PBN-91-06C	205,000	5.54E-02	0.14	-	-	-	240,000	6.49E-02
PBN-91-06D	196,000	5.30E-02	0.13	-	-	-	249,000	6.73E-02
Average:	233,000	$6.29 \times 10^{-2}$	0.11	273,000	7.38E-02	0.09	255,500	6.91E-02

(1) Boulton Delayed Yield Method not applicable for PBP-91-01B data.

(2) Jacob Drawdown Analyses not applicable for the more distant wells PBP-91-02 and PBN-91-06.



**TABLE 6-6**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	NEW WELLS	EXISTING WELLS
Propellant Burning Ground	PBN-89-01B,C,D PBN-89-02B,C PBN-89-03B,C PBN-89-04B,C PBM-89-05 PBM-89-06 PBM-89-07 PBM-89-08 PBM-89-09 PBM-89-10A,B,C,D PBM-89-11 PBN-89-12A,B PBN-91-06C,D PBN-91-12C,D	PBN-82-01A,B,C PBN-82-02A,B,C PBN-82-03A,B,C PBN-82-04A,B,C PBM-82-05A,B,C PBM-82-01 PBM-82-02 PBM-82-03 PBM-82-04 PBM-82-05 S1109 S1117 S1146 PBM-85-01 PBM-85-02 PBM-85-03 PBM-85-04 PBM-85-05 PBM-85-06 PBN-85-01A PBN-85-02A PBN-85-03A PBN-85-04A
Subtotal	25	33
Landfill 1	LOM-89-01 LON-89-02A,B LON-89-03A,B LOM-91-01 LOM-91-02	
Subtotal	7	0
Settling Ponds and Spoils Disposal Area	SPN-89-01C SPN-89-02A,B,C SPN-89-03B,C SPN-89-04B,C SPN-89-05A,B SPN-91-02D SPN-91-03D SPN-91-04D	S1101 S1102 S1103 S1104 S1105 S1106 S1107 S1108 S1133 S1147 S1148 S1149 S1152A,B



continued

**TABLE 6-6**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITES</b>	<b>NEW WELLS</b>	<b>EXISTING WELLS</b>
Subtotal	13	14
<b>TOTAL WELLS</b>	<b>45</b>	<b>47</b>

**Notes:**

A,B,C,D - Shallowest to deepest: A indicates shallowest well; D indicates deepest well in a well nest.



TABLE 6-7  
CHEMICAL ANALYSES PERFORMED ON SURFACE SOIL AND SEDIMENT SAMPLES -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	TOTAL METALS										INORGANICS				OTHER			ORGANICS						
	PP	TAL	CA	NA	CD	CR	HG	PB	CO	CH	CLP	METALS	ANIONS	NIT	NO4	NH3N2	TOC	pH	VOC	BW/A	MS	NAM	DMT	
PROPELLANT BURNING GROUND																								
Burning Pads																								
PBS-01-01	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-02	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-03	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-04	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-05	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-06	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-07	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-08	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-09	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-11	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-12	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-13	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-14	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-15	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-16	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-17	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-18	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-19	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-20	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-21	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-22	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-23	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-24	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-25	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-26	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-27	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-28	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-29	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-30	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-31	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-32	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-33	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-34	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-35	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-36	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	-	1
PBS-01-37	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1



TABLE 6-7  
 CHEMICAL ANALYSES PERFORMED ON SURFACE SOIL AND SEDIMENT SAMPLES -  
 PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS													OTHER			ORGANICS									
	TOTAL METALS								TCUP METALS					ANIONS		MH392	TOC	PH	VOC	BWA	HG	NAM	DNT			
	PP	TAL	CA	NA	CD	CR	HG	PB	CD	CR	HG	PB	ANIONS	MIT	SO4											
PBS-01-38	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-39	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-40	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1		
PBS-01-48	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
Contam. Waste Area																										
PBS-01-41	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-42	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-43	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-44	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-45	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-46	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-47	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-48	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	-	1		
Race Track/Burning Piles																										
PBS-01-50	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-51	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-52	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-53	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-54	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-55	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	-	1		
PBS-01-56	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-57	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-58	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-59	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-60	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-61	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-62	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-63	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-64	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-65	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	1	1	-	1		
PBS-01-66	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-67	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-68	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-69	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-70	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-71	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1		
PBS-01-72	1	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1		



[illegible]



TABLE 6-7  
CHEMICAL ANALYSES PERFORMED ON SURFACE SOIL AND SEDIMENT SAMPLES -  
PROPELLANT BURNING GROUNDLANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	TOTAL METALS										INORGANICS					OTHER					ORGANICS				
	TOTAL METALS										INORGANICS					OTHER					ORGANICS				
	PP	TAL	CA	NA	CD	CR	HG	PB	CO	CR	CD	CR	HG	PB	MIT	MIT	SO4	NH4N2	TOC	pH	VOC	BNIA	MS	NAM	DNT
P88-01-112	1	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	1	-	-	-	1
P88-01-113	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
P88-01-114	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
P88-01-115	1	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	1
P88-01-116	1	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	1
P88-01-117	1	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	1
P88-01-118	1	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	1
TOTALS	118	0	0	0	0	0	0	0	0	0	45	45	45	45	0	0	0	0	0	0	118	15	0	0	118

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SS, SE, TL, ZN)

TAL = Toxic Analytes List (23) (AL, SS, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BNIA = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography



TABLE 6-3  
CHEMICAL ANALYSES PERFORMED ON SUBSURFACE SOIL SAMPLES -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS																INORGANICS					TCLP METALS				ANIONS		OTHER				ORGANICS			
	METALS				METALS				METALS				METALS				METALS				ANIONS		OTHER				ORGANICS								
	PP	TAL	CO	CR	CU	HG	FE	NI	PB	ZN	CD	CR	HG	PB	NIT	SO4	TOC	PH	TPHC	VOC	BWA	NG	NAM	DNT	VOC	BWA	NG	NAM	DNT						
PROPELLANT BURNING GROUND																																			
PBB-91-01	12	--	--	--	--	--	--	--	--	--	2	2	2	2	2	12	12	--	--	--	12	1	--	1	12	--	--	--	1	12					
PBB-91-02	14	--	--	--	--	--	--	--	--	--	2	2	2	2	2	14	14	--	--	--	14	1	--	1	14	--	--	--	1	14					
PBB-91-03	14	--	--	--	--	--	--	--	--	--	2	2	2	2	2	14	14	--	--	--	14	2	--	1	14	--	--	--	1	14					
PBB-91-04	13	--	--	--	--	--	--	--	--	--	4	4	4	4	4	13	13	--	--	--	15	1	--	1	13	--	--	--	1	13					
PBB-91-05	12	--	--	--	--	--	--	--	--	--	2	2	2	2	2	12	12	--	--	--	13	2	--	1	12	--	--	--	1	12					
PBB-91-06	14	--	--	--	--	--	--	--	--	--	8	8	8	8	8	14	14	--	--	--	15	2	--	2	14	--	--	--	2	14					
PBB-91-07	13	--	--	--	--	--	--	--	--	--	7	7	7	7	7	13	13	--	--	--	13	1	--	1	13	--	--	--	1	13					
PBB-90-01(1)	--	1	--	--	9	--	--	--	9	9	--	--	--	--	--	--	--	--	--	--	10	1	--	--	9	--	--	--	--	9					
PBB-90-02(1)	--	1	--	--	9	--	--	--	9	9	--	--	--	--	--	--	--	--	--	--	10	--	--	--	9	--	--	--	--	9					
PBT-90-01(2)	--	--	--	--	2	--	--	--	2	2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2	--	--	--	--	2					
PBT-90-02(2)	--	--	--	--	1	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	--	1					
PBT-90-03(2)	--	--	--	--	3	--	--	--	3	3	--	--	--	--	--	--	--	--	--	--	3	--	--	--	3	--	--	--	--	3					
PBT-90-04(2)	--	--	--	--	1	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	--	1					
PBT-90-05(2)	--	--	--	--	2	--	--	--	2	2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2	--	--	--	--	2					
PBT-90-06(2)	--	--	--	--	2	--	--	--	2	2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2	--	--	--	--	2					
PBT-90-07(2)	--	--	--	--	2	--	--	--	2	2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2	--	--	--	--	2					
PBT-90-08(2)	--	--	--	--	3	--	--	--	3	3	--	--	--	--	--	--	--	--	--	--	3	--	--	--	3	--	--	--	--	3					
LANDFILL 1																																			
LOB-90-01(1)	--	1	--	--	8	--	--	--	8	8	--	--	--	--	--	--	--	--	--	--	9	1	--	--	8	--	--	--	--	8					
LOB-90-02(2)	--	--	--	--	1	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	--	1					
FINAL CREEK																																			
SPB-91-01	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	6	6	--	6	--	6	6	--	6	6	--	--	--	6	6					
TOTALS	92	9	0	0	43	0	0	0	43	43	27	27	27	27	27	98	98	0	6	0	148	18	0	14	141										

## NOTES:

BNA = base-neutral and acid-extractable organics by GC/MS

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

GC/MS = Gas Chromatography/Mass Spectrometry

HPLC = High Performance Liquid Chromatography

NAM = nitroamines by GC

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SE, TL, ZN)

TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

(1) Only one sample was analyzed for a full suite of VOCs, the remaining samples were analyzed for CCL4, TCLEE, and TRCLE only

(2) Analyzed for CCL4, TCLEE, and TRCLE only



TABLE 6-9  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS										INORGANICS					OTHER					ORGANICS				TPH
	PP	TAL	CA	NA	CO	CR	HG	PB	NI	ANIONS	NIT	CL	SO4	HARD	ALK	TDS	TOC	MHSH2	VOC	BWA	NG	NAM	DNT		
PROPELLANT BURNING GROUND																									
PBM-82-01	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-82-02	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-82-03	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-82-04	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-82-05	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-01	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-02	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-03	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-04	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-05	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBM-85-06	-	-	-	-	-	-	-	-	-	1	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-01 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-01 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-01 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-02 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-02 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-02 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-03 A	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-03 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-03 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-04 A	-	-	-	-	-	-	-	-	-	1	1	1	1	-	1	1	1	-	-	B	B	-	2	B	
PBN-82-04 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-04 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-05 A	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-05 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-82-05 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-85-01 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-85-02 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-85-03 A	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-85-04 A	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-01 B	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-01 C	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-01 D	-	-	-	-	B	B	B	B	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-02 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-02 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	
PBN-89-03 B	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	B	-	-	B	B	-	B	B	



TABLE 6-6  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS										OTHER					ORGANICS				TPH
	METALS					ANIONS		HAPD			TOC		VOC		NAM					
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	MIT	CL	SO4	ALK	TDS	NH3N2	BNA	NG	DNT		
PBN-89-03 C	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-04 B	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-04 C	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-05	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-06	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-07	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-08	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-09	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-10 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-10 B	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-10 C	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-10 D	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-11	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-12 A	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-89-12 B	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-91-06 C	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-91-06 D	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-91-12 C	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
PBN-91-12 D	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
LOM-89-01	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LON-89-02 A	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LON-89-02 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LON-89-03 A	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LON-89-03 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LOM-91-01	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
LOM-91-02	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
S1108	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
S1117	-	-	-	-	B	B	B	B	-	B	B	B	B	B	-	B	-	B	B	-
S1145	-	-	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
S1148*	-	-	-	-	-	-	-	-	-	2	2	2	2	2	-	B	-	B	B	-
SETTLING PONDS AND SPOILS DISPOSAL AREA																				
SPN-89-01 C	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
SPN-89-02 A	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
SPN-89-02 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
SPN-89-02 C	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
SPN-89-03 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-
SPN-89-03 C	-	B	-	-	-	-	-	-	-	B	B	B	B	B	-	B	-	B	B	-



TABLE 6-9  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS										INORGANICS				OTHER				ORGANICS				TPH
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	VOC	BN/A	NG	NAM	DNT	
SPN-89-04 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-89-04 C	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-89-05 A	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-89-05 B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-91-02 D	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-91-03 D	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
SPN-91-04 D	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1101 *	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	B	-	-	-	1	-
S1102	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1103	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1104	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1105	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1106	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1107	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1108	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1133	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1147	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1148	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1149	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1152A	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
S1152B	-	B	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	B	B	B	B	-
TOTALS	0	68	0	0	48	48	48	48	0	182	183	183	181	182	182	0	0	186	124	52	181	183	0

## NOTES:

BN/A = base-neutral and acid-extractable organics by GC/MS

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

GC/MS = Gas Chromatography/Mass Spectrometry

HPLC = High Performance Liquid Chromatography

NAM = nitroamines by GC

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)

TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

\* = Well did not contain adequate water for sampling.

B = Analyzed in both Rounds (One and Two).

1 = Analyzed in Round One only.

2 = Analyzed in Round Two only.



TABLE 6-10  
VERTICAL GROUNDWATER GRADIENTS -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS  
AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

WELL NEST	WATER LEVEL DIFFERENCE (FT.)/SCREEN SEPARATION (FT.)	VERTICAL GRADIENT (FT/FT)	COMMENT <sup>1</sup> (WATER LEVEL DIFFERENCE)
PBN-82-01A and B	0.02/19	0.0011u <sup>3</sup>	Insignificant <sup>2</sup>
PBN-82-01B and C	0.02/9	0.001u <sup>4</sup>	Insignificant
PBN-82-02A and B	0.12/17	0.007u	
PBN-82-02B and C	0.06/9	0.007d	
PBN-82-03A and B	0.01/16	0.0006u	Insignificant
PBN-82-03B and C	0.01/9	0.001d	Insignificant
PBN-82-04A and B	0.08/16	0.005u	Small
PBN-82-04B and C	0.0/10	0.0	None
PBN-82-05A and B <sup>5</sup>	0.09/15	0.006d	
PBN-82-05B and C	0.05/10	0.005u	Small
PBN-85-01A and PBN-89-01B	0.29/48	0.006d	
PBN-89-01B and C	0.11/32	0.0034u	
PBN-89-01C and D	0.01/43	0.0002u	Insignificant
PBN-85-02A and PBN-89-02B	1.31/28	0.047d	Substantial
PBN-89-02B and C	0.27/33	0.008u	
PBN-85-03A and PBN-89-03B	0.67/36	0.019d	
PBN-89-03B and C	0.68/35	0.019u	
PBN-85-04A and PBN-89-04B	0.34/37	0.009d	
PBN-89-04B and C	0.53/37	0.01u	
PBN-89-10A and B	0.06/46	0.001d	Small
PBN-89-10B and C	0.34/29	0.01u	
PBN-89-10C and D	0.26/48	0.005d	
PBN-89-12A and B	0.10/44	0.002d	Small
PBN-89-12B and PBN-91-12C	0.06/45	0.001	Small
PBN-91-12C and PBN-91-12D	0.05/45	0.001	Insignificant



continued

**TABLE 6-10**  
**VERTICAL GROUNDWATER GRADIENTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS**  
**AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL NEST	WATER LEVEL DIFFERENCE (FT.)/SCREEN SEPARATION (FT.)	VERTICAL GRADIENT (FT/FT)	COMMENT <sup>1</sup> (WATER LEVEL DIFFERENCE)
PBM-85-06 and PBN-91-06C	0.09/111	0.0008	Small
PBN-91-06C and PBN-91-06D	0.02/53	0.0004	Insignificant
S1101 and S1133	0.04/37	0.001u	Insignificant
S1133 and SPN-89-01C	0.05/24	0.002d	Small
SPN-89-02A and B	0.0/36	0.0	None
SPN-89-02B and C	0.01/30	0.0003d	Insignificant
SPN-89-02C and SPN-91-02D	0.0/53	0.0	None
S1147 and SPN-89-03B	0.10/33	0.003d	Small
SPN-89-03B and C	0.02/34	0.0006u	Insignificant
SPN-89-03C and SPN-91-03D	0.12/63	0.0019	
S1148 and SPN-89-04B	0.07/30	0.002d	Small
SPN-89-04B and C	0.04/32	0.001u	Insignificant
SPN-89-04C and SPN-91-04D	0.02/100	0.0002d	Insignificant
S1152A and B	0.0/22	0.0	None
S1152B and S1103	0.24/51	0.005u	



continued

**TABLE 6-10**  
**VERTICAL GROUNDWATER GRADIENTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS**  
**AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL NEST	WATER LEVEL DIFFERENCE (FT.)/SCREEN SEPARATION (FT.)	VERTICAL GRADIENT (FT/FT)	COMMENT <sup>1</sup> (WATER LEVEL DIFFERENCE)
S1104 and S1105	0.02/23	0.0009u	Insignificant
S1105 and S1106	0.06/26	0.0023d	Small
SPN-89-05A and B	0.09/43	0.002d	Small

**Notes:**

<sup>1</sup> Water levels measured on December 15, 1991.

<sup>2</sup> Insignificant gradient was concluded if the water level difference was less than the probable measurement accuracy considering the variance expected from two measurements.

<sup>3</sup> u = upward gradient

<sup>4</sup> d = downward gradient

<sup>5</sup> April 7, 1992 water levels

ft/ft = feet per foot



**TABLE 6-11**  
**HORIZONTAL GROUNDWATER GRADIENTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS**  
**AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL NEST	HORIZONTAL GRADIENT (FT/FT) <sup>1</sup>	COMMENT
PBM-89-11 LON-89-03A	0.0014	Northern Propellant Burning Ground; southeasterly flow vector
PBM-82-01 PBN-82-04A	0.0015	At Propellant Burning Ground; southeasterly flow vector
PBN-82-03A PBM-89-07	0.0013	South of Propellant Burning Ground; southerly flow vector
PBM-85-06 S1148	0.0014	Propellant Burning Ground and Settling Ponds and Spoils Disposal Area; southerly flow vector
PBN-89-10B PBN-89-01B	0.0014	Propellant Burning Ground; deep gravel/cobble zone; southerly flow vector
PBN-89-01B PBN-89-04B	0.0012	Propellant Burning Ground; deep gravel/cobble zone; southerly flow vector
PBN-89-04B PBN-89-12B	0.0015	Propellant Burning Ground; deep gravel/cobble zone; southerly flow vector

**Notes:**

<sup>1</sup> Water levels measured on December 15, 1991.

ft/ft = feet per foot



**TABLE 6-12**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
PBM-89-11	1.5	$4 \times 10^{-2}$	Fine to medium sand (SP)
PBN-82-03B	3.4	$1 \times 10^{-3}$	Medium-fine sand (SP-SM)
PBN-82-03C	9.0	$7 \times 10^{-4}$	Medium-fine sand (SP-SM)
PBN-89-01B	3.7	$3 \times 10^{-2}$	Gravel with sand and cobbles (GP)
PBN-89-01C	10.9	$3 \times 10^{-2}$	Fine to medium sand (SP-SW)
PBN-89-01D	4.3	$5 \times 10^{-2}$	Medium-fine sand with trace gravel (SW)
PBN-89-02B	11.0	$1 \times 10^{-2}$	Fine to medium sand (SP)
PBN-89-02C	12.1	$2 \times 10^{-2}$	Fine to medium sand (SP)
PBN-89-03B	8.7	$1 \times 10^{-2}$	Sand with trace gravel (SP)
PBN-89-03C	8.7	$4 \times 10^{-2}$	Sand with trace gravel (SP)
PBN-89-04C	5.8	$2 \times 10^{-2}$	Fine sand (SP-SW)
PBN-89-10B	1.5	$2 \times 10^{-1}$	Gravel with sand (GW-SP)
PBN-89-10C	8.5	$2 \times 10^{-2}$	Medium-fine sand, little gravel (SP-SW)
PBN-89-10D	10.7	$5 \times 10^{-2}$	Fine to coarse sand with gravel and cobbles (SP-GP)
PBN-91-06C	7.3	$1.6 \times 10^{-2}$	Medium to coarse sand, some gravel (SW)
PBN-91-12C	4.8	$8 \times 10^{-3}$	Medium to coarse sand with little fine sand and little gravel (SW)



continued

**TABLE 6-12**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
PBN-91-12D	10.3	$3 \times 10^{-2}$	Medium to coarse sand, some gravel, little fine sand (SW)
LON-89-02B	5.0	$4 \times 10^{-2}$	Gravel and cobbles (GP-GW)
LON-89-03B	2.0	$1 \times 10^{-1}$	medium sand and fine gravel (SP-GP)
SPN-89-01C	8.4	$4 \times 10^{-2}$	Fine sand (SP) over gravel (GP)
SPN-89-02B	9.3	$1 \times 10^{-2}$	Fine to medium sand (SP)
SPN-89-02C	9.3	$3 \times 10^{-2}$	Medium to coarse and (SP)
SPN-89-03B	8.4	$4 \times 10^{-2}$	Fine sand over gravel (SP-GW)
SPN-89-04B	8.5	$2 \times 10^{-2}$	Fine sand and some gravel (SP-GW)
SPN-89-04C	10.5	$2 \times 10^{-2}$	Fine sand trace gravel (SP)
S1103	3.4	$8 \times 10^{-3}$	Medium-fine sand with some gravel (SP, SP-SM)



continued

**TABLE 8-12**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
S1106	9.8	$7 \times 10^{-3}$	Medium-fine sand, little gravel (SP, SP-SM)
S1107	8.6	$3 \times 10^{-3}$	Medium-fine sand, little gravel (SP, SP-SM)
S1114	7.5	$2 \times 10^{-2}$	Medium-fine sand, little gravel (SP, SP-SM)

**Notes:**

Field data and calculations are presented in Appendix I. Hydraulic conductivities calculated using HVORSLEV method.

Hydraulic Conductivity Tests completed during March and November 1989, and November and December 1991.

Values of hydraulic conductivities represent an averaged value of multiple tests performed on each well.

cm/sec = centimeters per second

Water level recovery at this well impacted by inertial effects resulting in water level recovery above static water level. Hydraulic conductivity measurements may be greater than calculated at this well.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-01	PBS-91-02	PBS-91-03	PBS-91-04	PBS-91-05	PBS-91-06	PBS-91-07	PBS-91-08	PBS-91-09	PBS-91-10
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs	ACET	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	0.200	-	-	2.640
	CCL3F	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	-	-	-	-	-
	24DNT	-	9.880	-	-	3.160	-	-	-	40.000
	26DNT	-	-	-	-	-	-	-	-	3.410
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	6.200 GT
	BAANTR	-	-	-	-	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-
	BGHYP	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	6.200 GT
	DEP	-	-	-	-	-	-	-	-	-
	DNBP	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	30.800
	PHANTR	-	-	-	-	-	-	-	-	0.110
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	3.990	3.550	4.450	6.120	-	-	-	-	2.020
	AS	1.010	0.725	0.930	0.903	0.787	0.634	0.603	3.440	4.780
	BE	-	-	-	-	-	-	-	0.955	-
	CD	24.400	21.200	23.800	34.200	18.400	23.100	23.200	25.000	49.800
	CR	27.900	28.300	18.300	115.000	36.800	99.600	97.700	24.800	1090.000
	CU	-	-	-	0.189	-	0.094	0.066	-	0.922
	HG	-	-	-	-	-	-	-	-	-
	NI	16.000	15.500	18.100	22.400	14.100	16.700	15.500	15.200	33.500
	PB	230.000	450.000	140.000	1200.000	730.000	2000.000	2800.000	160.000	2700.000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	78.000	108.000	62.500	286.000	146.000	192.000	342.000	66.500	1040.000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-11	PBS-91-12	PBS-91-13	PBS-91-14	PBS-91-15	PBS-91-16	PBS-91-17	PBS-91-18	PBS-91-19	PBS-91-20
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs	ACET	-	-	-	-	-	0.006 S	-	-	-
	C6H6	0.199	0.420	-	-	-	-	-	-	-
	CCL3F	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	10.700	-	-	-	-
	24DNT	-	-	3.060	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-
	BGHPY	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	-
	DEP	-	-	-	-	-	-	-	-	2.060
	DNBP	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	-	-	-	-	-	-	-	-	-
	AS	2.880	-	-	-	4.140	-	3.250	-	3.630
	BE	0.796	0.975	0.559	0.768	0.652	0.531	0.960	0.830	0.949
	CD	-	-	-	-	-	-	-	-	-
	CR	28.000	26.400	19.300	19.700	31.000	13.200	22.100	21.500	26.000
	CU	93.400	25.900	138.000	27.400	142.000	119.000	15.800	32.500	20.700
	HG	0.058	-	0.093	-	0.161	-	0.199	-	-
	NI	22.500	16.700	16.300	14.700	23.600	12.700	13.700	15.200	17.900
	PB	790.000	220.000	1900.000	300.000	2800.000	3300.000	17.000	670.000	39.000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	225.000	102.000	290.000	69.700	337.000	202.000	71.200	111.000	78.200

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-21	PBS-91-22	PBS-91-23	PBS-91-24	PBS-91-25	PBS-91-26	PBS-91-27	PBS-91-28	PBS-91-29	PBS-91-30
Sample Type:										
UNITS:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
DATE SAMPLED:	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	09/24/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs										
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	0.003 S	0.003 S	-	-	-	-	-	-	-	-
CCL3F	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
SVOCs										
2MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	3.890	53.300	51.600	-	8.760	-
26DNT	-	-	-	-	-	4.250	-	-	-	-
ANAPNE	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
ANTRC	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BAPYR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DBAHA	-	-	-	-	-	-	-	-	-	-
DBZFUR	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
FLRENE	-	-	-	-	-	-	-	-	-	-
ICDPYR	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
Metals										
AG	-	-	-	-	-	-	-	-	-	-
AS	-	3.370	-	4.770	4.570	4.900	3.200	4.820	4.290	3.740
BE	0.978	1.000	1.030	0.780	0.861	0.731	0.690	0.856	0.840	0.857
CD	-	-	-	-	-	-	-	-	-	-
CR	25.400	27.000	24.000	19.100	25.000	27.700	14.700	18.200	17.500	18.200
CU	29.800	19.900	20.700	21.500	38.900	94.000	759.000	34.200	65.200	17.200
HG	0.070	0.156	0.465	-	0.082	0.173	0.096	0.061	0.334	-
NI	14.800	15.400	14.700	14.100	17.800	24.500	12.100	12.500	16.000	13.800
PB	68.000	25.000	21.000	380.000	2300.000	1800.000	580.000	120.000	290.000	120.000
SB	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	0.624	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
ZN	111.000	85.700	75.700	74.900	166.000	421.000	207.000	81.800	123.000	71.600

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-31	PBS-91-32	PBS-91-33	PBS-91-34	PBS-91-35	PBS-91-36	PBS-91-37	PBS-91-38	PBS-91-39	PBS-91-40
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs										
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	-	0.426	0.527	0.749	0.754	-	-	-	-	-
CCL3F	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
SVOCs										
2MNAP	-	14.300	5.610	8.460	-	-	-	4.660	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
ANAPNE	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
ANTRC	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BAPYR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DBAHA	-	-	-	-	-	-	-	-	-	-
DBZFUR	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
FLRENE	-	-	-	-	-	-	-	-	-	-
ICDPYR	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
Metals										
AG	-	-	-	-	-	-	-	25.800	-	-
AS	5.210	5.190	4.440	4.260	4.870	4.420	4.780	6.820	4.420	5.330
BE	0.850	-	0.684	0.707	0.784	0.840	0.652	-	0.737	0.810
CD	-	-	-	-	-	-	-	3.080	-	-
CR	29.400	60.500	33.000	20.900	19.400	25.100	30.900	24.500	19.400	24.700
CU	81.600	985.000	91.400	90.600	52.000	37.300	57.300	344.000	21.600	24.500
HG	0.205	0.328	0.115	0.103	0.081	0.102	0.122	0.125	-	-
NI	17.300	38.100	14.600	15.200	17.000	18.000	31.800	20.300	14.000	15.300
PB	1400.000	1100.000	1100.000	870.000	1100.000	1100.000	3300.000	3000.000	260.000	250.000
SB	-	-	-	-	-	-	-	404.000	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
ZN	174.000	655.000	254.000	171.000	1160.000	154.000	285.000	2700.000	80.700	154.000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-41	PBS-91-42	PBS-91-43	PBS-91-44	PBS-91-45	PBS-91-46	PBS-91-47	PBS-91-48	PBS-91-49	PBS-91-50
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	09/24/91	09/24/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs										
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-
CCL3F	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
SVOCs										
2MNAP								0.122		
24DNT	4.220	-	25.800	-	-	-	-	2.770	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
ANAPNE	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
ANTRC	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BAPYR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHIPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DBAHA	-	-	-	-	-	-	-	-	-	-
DBZFUR	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	0.794	-	-
FANT	-	-	-	-	-	-	-	3.280	-	-
FLRENE	-	-	-	-	-	-	-	0.145	-	-
ICDPYR	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	1.310	-	-
PVR	-	-	-	-	-	-	-	0.249	-	-
Metals										
AG	-	-	-	-	-	-	-	-	-	-
AS	24.700	8.310	64.000	3.490	4.680	11.000	4.650	5.600	5.300	3.570
BE	-	-	-	-	-	-	-	-	0.818	0.761
CD	4.480	1.700	-	-	-	-	-	-	-	-
CR	60.100	26.200	55.100	10.500	18.100	40.500	27.400	51.600	25.500	19.300
CU	2700.000	472.000	222.000	42.300	98.700	60.400	150.000	161.000	40.500	10.400
HG	0.258	0.072	7.700	-	-	0.061	-	0.430	-	-
NI	20.800	17.600	13.500	9.070	18.300	19.100	30.700	27.300	18.100	13.300
PB	1100.000	330.000	2100.000	200.000	190.000	120.000	930.000	1000.000	930.000	15.000
SB	-	-	-	-	-	-	-	-	-	-
SE	1.110	-	2.030	-	-	0.618	-	-	-	-
TI	1.190	-	2.280	-	-	-	-	-	-	-
ZN	5200.000	1700.000	219.000	132.000	554.000	340.000	817.000	1500.000	444.000	62.200

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-51	PBS-91-52	PBS-91-53	PBS-91-54	PBS-91-55	PBS-91-56	PBS-91-57	PBS-91-58	PBS-91-59	PBS-91-60
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs	ACET	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-
	CCL3F	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	-	-	-	-	-
	24DNT	-	-	-	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	BZEHP	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-
	BGHYPY	-	-	-	-	-	-	-	-	-
	BKZANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	-
	DEP	-	-	-	-	-	-	-	-	-
	DNBP	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	-	-	-	-	-	-	-	-	-
	AS	4.700	3.980	4.110	4.660	3.950	4.500	4.310	5.760	4.840
	BE	0.857	0.722	0.778	0.814	0.830	0.739	0.843	0.913	0.847
	CD	-	-	-	-	-	-	-	-	-
	CR	23.000	22.300	25.100	24.700	20.800	21.300	26.800	28.000	26.800
	CU	9.570	15.100	12.000	14.400	11.600	-	14.800	16.500	16.400
	HG	-	-	-	-	-	-	-	-	-
	NI	17.400	14.000	16.100	16.300	15.300	13.700	15.200	19.000	18.000
	PB	17.500	44.000	24.000	23.000	17.000	34.000	56.000	48.000	39.000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	54.200	64.300	61.900	58.300	60.100	61.100	73.100	65.100	67.000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-61	PBS-91-62	PBS-91-63	PBS-91-64	PBS-91-65	PBS-91-66	PBS-91-67	PBS-91-68	PBS-91-69	PBS-91-70
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/24/91	09/24/91	09/24/91	09/24/91	09/24/91	09/25/91	09/25/91	09/25/91	09/25/91	09/25/91
DEP IN:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs										
ACET										
C6H6										
CCL3F										
MEK				0.006 S						
SVOCs										
2MNAP										
24DNT										
26DNT										
ANAPNE										
ANAPYL										
ANTRC										
B2EHP										
BAANTR										
RAPYR										
BBFANT										
BGHIPI										
BKFANT										
CHRY										
DBAHA										
DBZFUR										
DEP										
DNBP										
FANT										
FLRENE										
ICDPYR										
NNDPA										
PHANTR										
PYR										
Metals										
AG	4.170	3.450		3.840	4.720	4.350	3.820	4.580		3.250
AS	0.735	0.886			0.835	0.781	0.832	0.522	0.507	0.807
BE										
CD	22.200	29.300	9.720	18.200	26.300	25.300	23.800	11.300	18.600	25.200
CR	10.200	15.100	21.200	35.500	13.900	13.000	15.100	19.000	55.200	12.100
CU										
HG										
NI	12.400	16.800	6.910	11.600	17.800	16.200	15.100	6.570	17.200	14.500
PB	14.000	22.000	45.000	150.000	14.000	22.000	36.000	36.000	330.000	17.000
SB										
SE										
TL										
ZN	46.500	73.100	39.100	61.300	55.400	50.500	75.900	27.000	74.900	65.100

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1, SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-71	PBS-91-72	PBS-91-73	PBS-91-74	PBS-91-75	PBS-91-76	PBS-91-77	PBS-91-78	PBS-91-79	PBS-91-80
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/25/91	09/25/91	09/25/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs	ACET	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-
	CCL3F	-	-	-	-	-	-	-	-	-
	MEK	0.006 S	-	-	-	-	-	0.004 S	0.005 S	-
SVOCs	2MNAP	-	-	-	0.452	-	-	-	-	-
	24DNT	-	-	-	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	0.204	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-
	BGHIPI	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	3.680	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	-
	DEP	-	-	-	4.010	-	-	-	-	-
	DNBP	-	-	-	0.200	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	1.320	-	-	-	-	-
	PHANTR	-	-	-	0.168	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	-	-	-	4.770	2.960	3.660	4.080	3.470	3.660
	AS	0.826	0.718	0.842	0.887	0.637	0.810	0.882	0.850	0.851
	BE	-	-	-	-	-	-	-	-	-
	CD	-	-	-	-	-	-	-	-	-
	CR	23.600	22.400	26.200	19.500	18.900	23.900	25.000	21.500	24.700
	CU	16.300	30.100	15.000	20.300	24.400	15.400	15.000	17.200	18.100
	HG	-	-	-	-	-	-	-	-	-
	NI	13.900	18.200	16.500	19.200	20.700	18.200	16.300	19.500	17.900
	PB	27.000	310.000	32.000	33.000	24.000	20.000	58.000	16.000	55.000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	64.100	71.400	76.300	60.500	40.700	81.100	70.900	60.400	85.000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-81	PBS-91-82	PBS-91-83	PBS-91-84	PBS-91-85	PBS-91-86	PBS-91-87	PBS-91-88	PBS-91-89	PBS-91-90
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91	09/30/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOCs	ACET	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-
	CCL3F	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	-	-	-	-	-
	24DNT	-	-	-	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	B8FANT	-	-	-	-	-	-	-	-	-
	BGHIPI	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	-
	DEP	-	-	-	-	-	-	-	-	-
	DNBP	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	-	-	-	-	-	-	-	2,340	-
	AS	-	7,700	3,340	-	3,150	3,890	-	3,570	-
	BE	-	0.640	0.861	0.829	0.578	1,510	0.893	0.003	-
	CD	-	-	-	-	-	-	-	-	-
	CR	7,150	23,900	23,100	23,600	19,500	15,300	22,400	23,400	14,900
	CU	20,200	29,100	13,700	27,700	13,300	39,000	14,200	17,200	25,600
	HG	-	-	-	-	-	-	-	-	-
	NI	7,220	21,800	14,800	16,600	14,400	20,300	17,100	17,700	12,300
	PB	86,000	640,000	23,000	260,000	34,000	18,000	24,000	110,000	76,000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	0.629	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	27,100	101,000	72,900	84,700	35,000	48,400	61,200	73,800	45,000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-91	PBS-91-92	PBS-91-93	PBS-91-94	PBS-91-95	PBS-91-96	PBS-91-97	PBS-91-98	PBS-91-99	PBS-91-100
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/30/91	09/30/91	09/30/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
VOC's										
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-
CCl3F	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
SVOC's										
2MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
ANAPNE	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
ANTRC	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BAPYR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DBAHA	-	-	-	-	-	-	-	-	-	-
DBZFUR	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
FLRENE	-	-	-	-	-	-	-	-	-	-
ICDPYR	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
Metals										
AG	-	-	-	-	-	-	-	-	-	-
AS	15.600	-	-	3.930	9.450	3.590	5.160	5.850	3.120	5.860
BE	-	1.570	2.290	0.853	0.920	-	0.648	0.673	-	-
CD	-	-	-	-	-	-	-	-	-	-
CR	21.800	21.100	48.100	23.800	29.700	25.200	26.500	29.100	20.900	23.100
CU	25.500	13.500	28.200	20.200	25.000	13.600	13.600	15.500	14.000	13.300
HG	-	-	-	-	-	-	-	-	-	-
NI	23.400	11.700	21.700	12.800	21.800	19.000	23.600	22.400	16.700	16.800
PB	1200.000	20.000	41.000	120.000	240.000	62.000	49.000	83.000	15.000	52.000
SB	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	0.731	0.603	0.606	-	-
TL	-	-	-	-	-	-	-	-	-	-
ZN	106.000	79.500	168.000	77.400	93.200	70.900	60.400	64.600	58.800	64.100

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-101	PBS-91-102	PBS-91-103	PBS-91-104	PBS-91-105	PBS-91-106	PBS-91-107	PBS-91-108	PBS-91-109	PBS-91-110
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	10/01/91	09/22/91	09/22/91	09/23/91	09/23/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.000	3.000
VOCs	ACET	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-
	CCl3F	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	-	-	-	-	-
	24DNT	-	-	-	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-
	ANTRC	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-
	BAASTR	-	-	-	-	-	-	-	-	-
	BAPYR	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-
	BGHIPI	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-
	DBAHA	-	-	-	-	-	-	-	-	-
	DBZFUR	-	-	-	-	-	-	-	-	-
	DEP	-	-	-	-	-	-	-	-	-
	DNBP	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-
	ICDPYR	-	-	-	-	-	-	-	-	-
	NNDFA	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-
Metals	AG	-	-	-	-	-	-	-	-	-
	AS	3.450	3.460	4.750	24.700	3.360	3.660	3.810	3.530	3.580
	BE	-	-	-	-	-	0.870	1.110	0.917	0.960
	CD	-	-	-	-	-	-	-	-	-
	CR	25.300	23.100	26.200	89.800	21.600	27.400	30.000	22.100	26.900
	CU	10.900	12.900	11.800	217.000	12.100	13.100	16.400	21.600	23.300
	HG	-	-	-	3.300	-	-	0.090	0.160	-
	NI	17.600	15.400	19.000	63.900	16.600	16.300	17.400	14.500	15.600
	PB	15.000	23.000	34.000	130.000	19.000	19.000	24.000	8.600	13.000
	SB	-	-	-	-	-	-	-	-	-
	SE	-	-	0.591	-	0.581	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-
	ZN	73.400	66.900	59.400	188.000	66.600	54.100	79.800	72.400	66.000

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBS-91-111	PBS-91-112	PBS-91-113	PBS-91-114	PBS-91-115	PBS-91-116	PBS-91-117	PBS-91-118
Sample Type:	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR	BUGR
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/23/91	09/23/91	09/23/91	09/23/91	09/23/91	10/01/91	10/01/91	10/03/91
DEPTH:	3.500	3.000	3.000	3.000	3.000	3.000	3.000	3.000
VOCs								
ACET	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-
CCL3F	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-
SVOCs								
2MNAP	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-
ANAPNE	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-
ANTRC	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-
BAPYR	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-
DBAHA	-	-	-	-	-	-	-	-
DBZFUR	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-
FLRENE	-	-	-	-	-	-	-	-
ICDPYR	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-
Metals								
AG	3.390	4.040	5.110	3.100	4.080	6.570	15.400	8.600
AS	0.986	1.260	1.460	0.935	1.200	0.624	-	0.632
BE	-	-	-	-	-	-	-	-
CD	25.100	36.500	40.400	23.800	28.100	30.700	33.500	23.400
CR	14.500	16.800	21.900	11.200	24.900	18.200	40.000	27.500
CU	0.071	0.079	-	-	-	-	0.060	-
HG	15.700	18.400	21.200	13.700	19.000	23.600	25.500	16.200
NI	65.000	16.000	15.000	15.000	840.000	20.000	1200.000	1500.000
PB	-	-	-	-	-	-	-	-
SB	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-
ZN	73.600	60.600	71.000	64.300	73.400	55.600	169.000	81.100

Notes and flagging codes are presented at the end of this table.



TABLE 6-13  
SUMMARY OF SURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS AND DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOCs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
-	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RJ Report Glossary.



**TABLE 6-14**  
**SUMMARY OF TCLP METALS DATA FOR SURFACE SOIL -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SAMPLE LOCATION	TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )				NOTES
	CD	CR	PB	HG	
TCLP RL <sup>1</sup>	1,000	5,000	5,000	200	
Minimum Reporting Value	6.8	16.8	43.4	0.1	
PBS-91-03	LT <sup>2</sup>	LT	LT	LT	TCLP RL not exceeded
PBS-91-06	LT	LT	7,790	LT	TCLP RL exceeded for PB
PBS-91-10	31.2	18.9	100,000	LT	TCLP RL exceeded for PB
PBS-91-12	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-15	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-16	LT	LT	6,050	LT	TCLP RL exceeded for PB
PBS-91-18	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-21	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-23	--	--	--	LT	TCLP RL not exceeded
PBS-91-24	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-27	LT	LT	8,310	LT	TCLP RL exceeded for PB
PBS-91-29	LT	LT	1,140	LT	TCLP RL not exceeded
PBS-91-33	LT	LT	2,070	LT	TCLP RL not exceeded
PBS-91-34	LT	LT	1,620	LT	TCLP RL not exceeded
PBS-91-36	LT	LT	910	LT	TCLP RL not exceeded
PBS-91-39	LT	LT	LT	LT	TCLP RL not exceeded
<u>Contaminated Waste Area</u>					
PBS-91-43	LT	LT	315	LT	TCLP RL not exceeded
PBS-91-44	LT	LT	604	LT	TCLP RL not exceeded
PBS-91-45	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-48	LT	LT	28,000	LT	TCLP RL exceeded for PB
PBS-91-49	LT	LT	5,730	LT	TCLP RL exceeded for PB
PBS-91-52	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-55	LT	LT	LT	LT	TCLP RL not exceeded



continued

**TABLE 6-14**  
**SUMMARY OF TCLP METALS DATA FOR SURFACE SOIL -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )					
SAMPLE LOCATION	CD	CR	PB	HG	NOTES
PBS-91-58	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-61	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-65	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-66	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-69	LT	LT	1,130	LT	TCLP RL not exceeded
PBS-91-72	LT	LT	209	LT	TCLP RL not exceeded
PBS-91-75	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-79	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-82	LT	LT	928	LT	TCLP RL not exceeded
PBS-91-85	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-88	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-91	LT	LT	246	LT	TCLP RL not exceeded
PBS-91-95	LT	LT	122	LT	TCLP RL not exceeded
PBS-91-96	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-99	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-102	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-105	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-109	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-112	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-115	LT	LT	546	LT	TCLP RL not exceeded
PBS-91-116	LT	LT	LT	LT	TCLP RL not exceeded
PBS-91-118	LT	LT	397	LT	TCLP RL not exceeded

**Notes:**

- <sup>1</sup> TCLP Regulatory Level (RLs) exist for the following metals: AS, BA, CD, CR, SE, PB, HG, and AG. However, these results were reported only for CD, CR, PB, and HG. (See List of USATHAMA Chemical Codes for definitions of chemical abbreviations).
- <sup>2</sup> LT - Less than the Minimum Reporting Value; corrected for percent moisture, dilution, and percent recovery.



TABLE 6-15  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Location	Final Creek Samples								Settling Pond 1 Samples						
	FC-1	FC-2	FC-3	FC-4	FC-5	FC-6	FC-7	FC-8	FPI-1	FPI-2	FPI-3	FPI-4	FPI-5	FPI-6	FPI-7
AL	890	14000	5700	12000	2700	1100	10000	3000	21000	18000	1400	27000	10000	14000	23000
FE															
PB	8.6	14	40	12	3.6	12	27	12	14	31	ND	30	170	15	13
K	34	680	460	920	230	26	790	210	750	720	69	1100	760	900	1100
NA	23	84	140	180	170	18	100	74	83	63	17	82	190	110	130
SN	50	49	41	41	25	47	63	ND	26	43	40	57	46	40	38
ZN															
BR															
CL															
NIT	1.6	8.4	11	2.2	1.9	2.4	6.5	4.1	2.5	6.5	0.54	1.1	12	3.1	1.4
NH3	24	187	140	81	56	44	1800	93	600	740	75	390	580	300	100
SO4	107	260	28	ND	ND	ND	33	ND	ND	ND	ND	82	2500	ND	ND
CH2CL2															
2,4-DNT	0.2	0.17	6	ND	1.9	ND	2.1	ND	ND	1.9	ND	ND	0.03	ND	ND
2,6-DNT	5.4	2.04	40	ND	25	1.6	22	ND	ND	18	ND	ND	9.1	0.4	ND
B2EHP															
DEP	ND	ND	0.11	ND	ND	ND	0.13	ND	ND	ND	ND	ND	ND	ND	ND
DNBP	3.6	3.2	26	ND	ND	1.7	7.9	ND	ND	11	0.67	ND	ND	ND	0.1
DNOP															
DPA	0.93	0.48	15	ND	4.7	0.22	3.5	ND	ND	3.3	ND	ND	10	0.25	ND
2NDPA	ND	ND	2	ND	0.57	ND	0.77	ND	ND	0.97	ND	ND	ND	ND	ND
NC	100	440	740	ND	ND	ND	ND	ND	ND	780	ND	180	60000	ND	ND
NG															
pH	7.74	7.79	7.78	7.9	7.55	7.9	6.42	8.03	6.9	6.78	6.88	5.13	5.39	5.32	5.66
COD	1300	35000	103000	20000	11000	6900	69000	24000	56000	60000	2400	76000	150000	51000	38000
TOC															



**TABLE 6-15**  
**SUMMARY OF SURFACE SOIL CHEMICAL DATA -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

[illegible]



**TABLE 6-15**  
**SUMMARY OF SURFACE SOIL CHEMICAL DATA -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

[illegible]



**TABLE 6-15**  
**SUMMARY OF SURFACE SOIL CHEMICAL DATA -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT[illegible]



TABLE 6-15  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Location	Spoils Disposal Site 1					Spoils Disposal Site 2					Spoils Disposal Site 3				
	SD1-1	SD1-2	SD1-3	SD1-4	SD1-5	SD2-1	SD2-2	SD2-3	SD2-4	SD2-5	SD3-1	SD3-2	SD3-3	SD3-4	SD3-5
AL	12487	14220	37395	44258	31282	4547	37583	49398	19841	25918	10844	7123	14963	26530	18207
FE	4162	10902	35401	29418	16535	17231	15534	17348	18674	15950	10623	5224	14746	15918	14566
PB	42	119	349	75	210	239	326	370	373	299	44	24	43	34	58
K	283	561	55	1660	1229	445	566	469	560	437	443	332	577	1327	121
NA	150	90	92	199	94	235	125	123	215	130	146	95	182	139	165
SN	3.27	3.5	3.46	3.68	2.54	1.04	2.6	4.04	2.54	3.68	2.24	1.33	1.36	5.8	1.28
ZN	129	128	170	212	63	148	220	307	326	748	84	119	243	96	126
BR		12		12			4								
CL	15	13	19	14	15	16	21	19	23	16	12	11	11	11	11
NIT	8	9	16	8	16	8	10	10	10	8	13	13	11	9	9
NH3															
SO4	33	50	146	80	126	97	93	130	80	85	29	31	36	75	30
CH2CL2			0.08	0.01				0.017	0.012	0.024		0.025			
2,4-DNT	9.8	0.034	0.51		12		0.54	1.3	0.84	0.48	0.47		1.1		
2,6-DNT					1										
B2EHP					0.35										
DEP															
DNBP	51	0.82	5.4	2.2	34	0.98	3.1	5.8	5.2	3.2	1.6	0.26	4		0.69
DNOP	8.6														
DPA	24		2.1	0.34	20	0.24	1.5	3.2	1.8	0.79	0.25		1.1		
2NDPA															
NC	11000	6000	9200	8700	10000	6100	5900	7800	8000	5800	2200	550	1400	450	2000
NG	19														
pH	8.3	8.4	8.3	8.4	8.3	8.3	7.6	8.3	8.2	8.2	8.1	7.8	8.1	7.6	7.8
COD	12000	23000	32000	22000	43000	48000	46000	40000	44000	46000	18000	22000	19000	33000	15000
TOC	4100	70000	64000	63000	56000	48000	58000	98000	69000	66000	10000	13000	17000	13000	19000



TABLE 6-15  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Location	Spoils Disposal Site 3 (continued)										Spoils Disposal Site 4									
	SD3-6	SD3-7	SD3-8	SD3-9	SD3-10	SD4-1	SD4-2	SD4-3	SD4-4	SD4-5	SD4-6	SD4-7	SD4-8	SD4-9	SD4-10					
AL	13849	11452	11277	11131	15459	11511	20197	17810	16500	17086	12059	18270	20865	18919	20612					
FE	14714	11685	13365	12912	15696	13512	16684	15204	16117	15915	13915	16864	19894	18201	17945					
PB	43	50	42	67	48	35	22	43	27	47	23	117	24	120	24					
K	1298	473	543	445	642	415	650	1195	1535	1250	455	539	1456	1317	1819					
NA	286	194	167	129	247	115	255	248	130	112	121	98	175	104	223					
SN	1.58	1.16	2.01	1.74	1.38	0.91	0.65	1.64	1.21	1.11	0.8	1.28	0.63	1.31	1.21					
ZN	95	139	251	129	186	100	97	130	192	89	204	108	175	144	175					
BR																				
CL	13	10	13	10	17		10	11	13	10	10	10	11	11	10					
NIT	22	9	12	9	10	4	12	8	8	7	5	9	8	7	11					
NH3																				
SO4	33	51	37	31	70	30	30	27	24	26	30	44	26	139	22					
CH2CL2						0.031			0.016			0.01		0.038						
2,4-DNT	0.83	0.24	0.63						0.7											
2,6-DNT																				
B2EHP																				
DEP									0.32											
DNBP	3.6	1.9	2.8	1.2	0.78				4.4	0.32		0.51		0.75						
DNOP					0.42					0.22	0.63			0.37						
DPA	2.2	0.46	0.79						1.1											
2NDPA																				
NC	3200	2400	3800	2900	2000	110		1600	660	230	65	1800	33	3000	140					
NG																				
pH	7.8	8	8	8.3	8	7.7	6.1	8.2	7.4	7.7	7	7.9	5.6	8.2	7.1					
COD	17000	34000	35000	22000	22000	9200	17000	20000	15000	16000	9200	20000	11000	28000	24000					
TUC	16000	20000	16000	16000	14000	12000	9100	16000	20000	18000	4600	25000	6100	38000	18000					



TABLE 6-15  
SUMMARY OF SURFACE SOIL CHEMICAL DATA -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Location	Spoils Disposal Site 5										COUNT	MIN	MAX	AVG
	SD5-1	SD5-2	SD5-3	SD5-4	SD5-5	SD5-6	SD5-7	SD5-8	SD5-9	SD5-10				
AL	19436	16567	14776	18354	14759	13075	10138		3684	10282	93	890	60000	16273.16
FE	16518	14329	17731	18922	15935	17067	12522		10591	10990	39	4162	35401	15627.18
PB	73	45	23	102	41	24			23	35	90	3.6	373	68.60
K	1336	685	1250	1230	1124	527	531		111	356	89	25	1900	700.91
NA	214	130	68	159	123	117	188	216	189	64	89	1.1	460	136.02
SN	1.23	1.64	1.43	0.78	0.63	0.93	1.71	0.73	1.28	1.94	93	0.45	77	23.12
ZN	112	121	155	239	306	151	121		101	103	39	63	748	172.87
BR							16				4	4	16	11.00
CL	10	13	13		13	13	18	15	13	14	38	10	23	13.37
NT	12	12	18	9	11	15	9	14	7	15	90	0.2	43	7.08
NH3											50	21	1800	289.14
SO4	25	33	28	25	31	38	29	23	24	24	58	22	2500	179.78
CH2CL2							0.014	0.026	0.01		14	0.01	0.08	0.02
2,4-DNT											25	0.03	172	12.80
2,6-DNT											14	0.16	40	11.87
B2EHP											2	0.32	0.35	0.34
DEP											5	0.11	460	127.85
DNBP			2.8	6.5		0.82	0.34	1.7	0.33	1.1	47	0.1	51	5.57
DNOP			0.2								6	0.2	8.6	1.74
DPA			0.91	2.4		0.22					37	0.22	24	3.18
2NDPA											6	0.57	2	0.97
NC	320	270	1800	11000			250	4800	530	1700	53	33	60000	4784.19
NG											1	19	19	19.00
pH	7.7	8.4	7.2	7.4	6.1	5.8	7.9	7.3	8.2	8.2	90	4.85	8.4	7.39
COD	18000	28000	18000	28000	24000	15000	7100	13000	13000	11000	89	890	260000	36435.84
TOC	15000	7100	11000	58000	16000	15000	13000	32000	13000	19000	40	4100	98000	27900.00

SOURCES:

Ayres Associates, 1984 (FC-.FP1-.FP2-.FP3-.FP4-)

Envirodyne Engineers, Inc., 1981 (S1201.S1202.S1203)

Foth & Van Dyke, 1985 (SD1-.SD2-.SD3-.SD4-.SD5-)

NOTES:

All concentrations are in milligrams per kilogram (mg/kg), equivalent to micrograms per gram (ug/g)

- - - Not tested.

NID - Concentration not detected above instrument Certified Reporting Limit



TABLE 6-16  
SUMMARY OF SURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING POND AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBB-90-01 BORE UGG 08/22/90 0.00	PBB-90-01 BORE UGG 08/22/90 5.00	PBB-90-01 BORE UGG 08/22/90 10.00	PBB-90-01 BORE UGG 08/22/90 15.00	PBB-90-01 BORE UGG 08/22/90 20.00	PBB-90-01 BORE UGG 08/22/90 25.00	PBB-90-01 BORE UGG 08/22/90 45.00	PBB-90-01 BORE UGG 08/22/90 70.00	PBB-90-01 BORE UGG 08/22/90 85.00	PBB-90-01 BORE UGG 08/22/90 100.00
<b>VOCs</b>										
1,1,1-TCE	-	-	-	-	-	-	-	-	-	-
1,2-DCE	-	-	-	-	-	-	-	-	-	-
1,3-DMB	-	-	-	-	-	-	-	-	-	-
4-E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-
CGH6	-	-	-	-	-	-	-	-	-	-
CCLA	-	-	-	-	-	-	-	-	-	-
CHXCL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
MIBK	-	-	-	-	-	-	-	-	-	-
TCLE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
<b>SVOCs</b>										
XYLEN	-	-	-	-	-	-	-	-	-	-
2-MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAAHTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHIPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
AG	-	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	-	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-	-
<b>Anions</b>										
NIT	-	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-	-
<b>Indicator parameter</b>										
pH(1)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02	PBB-90-02
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90	08/23/90
DEPTH:	0.000	5.000	10.000	15.000	20.000	25.000	45.000	65.000	85.000	95.000
VOCs										
1,1,1-TCE	-	-	-	-	-	-	-	-	-	-
1,2-DCE	-	-	-	-	-	-	-	-	-	-
1,3-DMB	-	-	-	-	-	-	-	-	-	-
4-E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
MIPK	-	-	-	-	-	-	-	-	-	-
TCLE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
XYLEN	-	-	-	-	-	-	-	-	-	-
2-MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHIPT	-	-	-	-	-	-	-	-	-	-
BRFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
AG	-	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	-	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-	-
ANIONS										
NIT	-	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-	-
Indicator										
Parameter										
pH(1)										

tes and flagging codes are presented at the end of this table



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01	PBB-91-01
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91	10/11/91
DEPTH:	8.000	12.000	16.000	18.000	22.000	31.000	41.000	51.000	61.000	71.000	81.000
VOCs	1,1,1TCE	0.002 S	-	-	-	-	-	-	-	-	-
	1,2DCE	-	-	-	-	-	-	-	-	-	-
	1,3DMB	-	-	-	-	-	-	-	-	-	-
	4E2MHX	-	-	-	-	-	-	-	-	-	-
	ACET	0.002 S	-	-	-	-	-	0.001 S	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-	-
	CCL4	-	-	-	-	-	-	-	-	-	-
	CH2CL2	-	-	-	-	-	-	-	-	-	-
	ETC6H5	-	-	-	-	-	-	-	-	-	-
	MEC6H5	-	-	-	-	-	-	-	-	-	-
	MEK	0.003 S	0.003 S	0.003 S	0.003 S	0.003 S	0.003 S	0.003 S	0.003 S	0.004 S	0.004 S
	MIBK	-	-	-	-	-	-	-	-	-	-
	TCLE	-	-	-	-	-	-	-	-	-	-
	TRCLE	-	-	-	-	-	-	-	-	-	-
	TXYLEN	-	-	-	-	-	-	-	-	-	-
	XYLEN	-	-	-	-	-	-	-	-	-	-
	2MNA	-	-	-	-	-	-	-	-	-	-
SVOCs	24DNT	165.000	-	-	-	-	-	-	-	-	-
	26DNT	5.960	-	-	-	-	-	-	-	-	-
	35DNA	-	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-	-
	B2ENP	-	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-	-
	BGHPY	-	-	-	-	-	-	-	-	-	-
	BKFA	-	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-	-
	DNEP	-	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-	-
	NAP	-	-	-	-	-	-	-	-	-	-
	NBUETH	-	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-	-
	PYB	-	-	-	-	-	-	-	-	-	-
	AG	1.050	0.976	1.230	0.866	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-
	AS	29.500	-	-	-	-	-	-	-	-	-
	BA	1.270	0.497	0.565	-	-	-	-	-	-	-
	BE	-	-	-	-	-	-	-	-	-	-
	CA	1.660	-	-	-	-	-	-	-	-	-
	CD	-	-	-	-	-	-	-	-	-	-
	CO	63.300	9.330	14.700	9.370	5.510	2.390	10.800	3.040	3.090	3.090
	CR	31.900	22.300	53.300	23.900	11.300	-	-	5.300	5.470	5.470
	CU	-	-	-	-	-	-	-	-	-	-
	FE	-	-	-	-	-	-	-	-	-	-
	HG	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-
	MG	-	-	-	-	-	-	-	-	-	-
	MN	-	-	-	-	-	-	-	-	-	-
	NA	27.900	9.880	30.300	12.400	6.320	-	3.430	3.370	-	-
	NI	130.000	1.750	2.030	1.410	1.600	1.320	1.230	1.340	1.210	1.210
	PB	-	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-	-
	V	-	-	-	-	-	-	-	-	-	-
	ZN	132.000	14.500	28.800	15.100	9.720	1.090	2.770	5.250	5.250	5.250
	NIT	17.100	3.710	2.430	5.430	1.910	-	-	-	-	-
	S04	109.000	9.050	14.400	13.900	16.200	-	-	-	-	-
Indicator	pH(1)	-	-	-	-	-	-	-	-	-	-
Parameter	-	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBB-91-01		PBB-91-02		PBB-91-02		PBB-91-02		PBB-91-02		PBB-91-02		PBB-91-02		PBB-91-02		PBB-91-02	
	BORE UGG 10/11/91 91.000	BORE UGG 10/11/91 105.000	BORE UGG 10/11/91 1.000	BORE UGG 10/11/91 4.000	BORE UGG 10/11/91 12.000	BORE UGG 10/11/91 18.000	BORE UGG 10/11/91 20.000	BORE UGG 10/11/91 22.000	BORE UGG 10/11/91 27.000	BORE UGG 10/11/91 32.000	BORE UGG 10/11/91 37.000	BORE UGG 10/11/91 42.000	BORE UGG 10/11/91 47.000	BORE UGG 10/11/91 52.000	BORE UGG 10/11/91 57.000	BORE UGG 10/11/91 62.000	BORE UGG 10/11/91 67.000	
VOCs																		
	11TCE	0.001 S			10.000 GT													
	12DCE																	
	13DMB																	
	4E2MHX																	
	ACET																	
	C6H6																	
	CCL4																	
	CH2CL2	0.001 S																
	ETC6H5																	
	MEC6H5																	
	MEK																	
	MIBK																	
	TCLEF																	
	TRCLE																	
	TXYLEN	0.001 S			10.000 GT													
	XYLEN																	
	2MNAP																	
	24DNT				58.900													
	24DNT																	
	35DNA																	
	ANAPYL																	
	B2EHP																	
	BAANTR																	
	BBFANT																	
	BGHFPT																	
	BKFANT																	
	CHRY																	
	DNBP																	
	FANT																	
	NAP																	
	NBUETH																	
	NNDPA																	
	PHANTR																	
	PYR																	
	AG																	
	AL				5.470													
	AS																	
	BA																	
	BE			0.997														
	CA																	
	CD																	
	CO																	
	CR	2.680	6.600	28.600														
	CU		6.410	243.000														
	FE																	
	HG																	
	K																	
	MG																	
	MN																	
	NA																	
	NI		3.590	22.400														
	PB	0.581	1.080		21.000													
	SE																	
	TL																	
	V																	
	ZN	6.120	5.830	63.800														
	NI	1.130	1.280		16.200													
	SO4		7.800		61.500													
	pH(1)																	
Antons																		
Indicator parameter																		

ns and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBB-91-02 BORE UGG 10/11/91 52.000	PBB-91-02 BORE UGG 10/12/91 62.000	PBB-91-02 BORE UGG 10/12/91 77.000	PBB-91-02 BORE UGG 10/12/91 87.000	PBB-91-02 BORE UGG 10/12/91 92.000	PBB-91-02 BORE UGG 10/12/91 102.000	PBB-91-02 BORE UGG 10/12/91 117.000	PBB-91-03 BORE UGG 10/12/91 4.000	PBB-91-03 BORE UGG 10/12/91 6.000	PBB-91-03 BORE UGG 10/12/91 12.000
<b>VOCs</b>										
111TCE	-	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	0.005 S	0.001 S
C6H6	-	-	-	-	-	-	-	-	-	-
CCLA	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	0.005 S	0.005 S	0.003 S
MIBK	-	-	-	-	-	-	-	-	-	-
MIBX	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
<b>SVOCs</b>										
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BZANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHFT	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
AG	-	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	5.500	7.240	-
AS	-	-	-	-	-	-	-	0.654	0.781	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	2.350	7.120	5.830	17.300	4.410	4.830	5.760	25.200	27.000	7.250
CU	-	3.620	8.140	12.300	11.100	5.920	7.450	17.500	14.900	32.900
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	0.067	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	5.860	4.710	3.300	3.770	4.560	16.500	18.900	10.400
NI	1.310	1.210	2.050	1.920	1.620	1.010	1.220	67.000	17.000	4.530
PB	-	-	-	-	-	-	-	0.762	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
ZN	2.670	3.320	10.100	15.600	7.480	5.790	28.800	67.400	58.100	17.900
<b>Anions</b>										
NO3	-	-	-	-	-	-	-	35.000	13.400	-
SO4	-	-	-	-	-	-	6.270	41.900	12.700	-
<b>Indicator parameter</b>										
pH(1)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBB-91-03 BORE UGG 10/12/91 16.000	PBB-91-03 BORE UGG 10/12/91 18.000	PBB-91-03 BORE UGG 10/12/91 22.000	PBB-91-03 BORE UGG 10/12/91 30.000	PBB-91-03 BORE UGG 10/12/91 41.000	PBB-91-03 BORE UGG 10/12/91 51.000	PBB-91-03 BORE UGG 10/12/91 61.000	PBB-91-03 BORE UGG 10/12/91 71.000	PBB-91-03 BORE UGG 10/12/91 81.000	PBB-91-03 BORE UGG 10/12/91 91.000
<b>VOCs</b>										
1,1,1-TCE	-	-	-	-	-	-	-	-	-	-
1,2-DCE	-	-	-	-	-	-	-	-	-	-
1,3-DMB	-	-	-	-	-	-	-	-	-	-
4-E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	0.001 S	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	0.003 S	0.003 S	-	0.002 S	0.002 S	0.003 S	-	0.003 S	-	0.003 S
MIBK	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
<b>SVOCs</b>										
2-MNAP	-	-	-	-	-	-	-	-	-	-
2,4-DNT	-	-	-	-	-	-	-	-	-	-
2,6-DNT	-	-	-	-	-	-	-	-	-	-
3,5-DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
BZEHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGRIPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
AG	-	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	-	-	3.310
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	0.478	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	3.340	2.530	3.460	2.920	2.340	2.760	2.910	7.460	5.390	4.460
CU	7.420	-	-	-	-	-	-	15.300	15.200	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	4.960	3.020	1.450	3.220	1.430	0.935	1.750	10.400	10.100	3.950
PB	2.610	1.320	-	1.140	-	-	-	1.410	2.720	2.990
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
ZN	5.230	3.130	2.820	1.180	1.270	-	-	17.800	1.360	-
<b>Anions</b>										
NO3	-	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-	-
<b>Indicator parameter</b>										
pH(1)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



**TABLE 6-16**  
**SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -**  
**PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

Site ID:	PBB-91-03	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/12/91	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91
DEPTH:	101.000	8.000	12.000	16.000	22.000	26.000	32.000	47.000	52.000	66.500
VOCs										
111TCE	-	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	0.001 S	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
MIBK	0.003 S	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
SVOCs										
XYLEN	-	-	-	-	-	-	-	-	-	-
2MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BREANT	-	-	-	-	-	-	-	-	-	-
BGRIPY	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDEFA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PVR	-	-	-	-	-	-	-	-	-	-
Metals										
AL	-	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	5.490	8.740	7.130	2.840	3.600	3.120	3.120	2.890	2.640	2.640
CU	-	36.500	18.200	6.090	9.930	4.270	4.270	-	4.150	4.150
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	3.830	12.500	5.920	2.830	5.370	2.080	2.080	2.360	1.360	1.360
PB	1.260	1.550	1.680	-	2.370	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
Anions										
NI	-	20.400	17.800	6.530	8.540	6.270	6.270	3.960	4.380	4.380
NT	-	2.640	1.940	3.840	6.530	12.400	12.400	3.430	6.230	6.230
SO4	-	-	-	-	-	-	-	100.000	-	50.500
Indicator parameter										
pH(I)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-04	PBB-91-05	PBB-91-05	PBB-91-05	PBB-91-05
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/13/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91
DEPTH:	62.000	72.000	82.000	92.000	102.000	107.000	14.000	26.000	26.000	26.000	26.000	26.000
VOCs	111TCE	-	-	-	-	-	-	-	-	-	-	-
	12DCE	-	-	-	-	-	-	-	-	-	-	-
	13DMB	-	-	-	-	-	-	-	-	-	-	-
	4E2MHX	-	-	-	-	-	-	-	-	-	-	-
	ACET	-	-	-	-	-	-	-	-	-	-	-
	C6H6	-	-	-	-	-	-	-	-	-	-	-
	CCL4	-	-	-	-	-	-	-	-	-	-	-
	CH2CL2	-	-	-	-	-	-	-	-	-	-	-
	ETC6H5	-	-	-	-	-	-	-	-	-	-	-
	MEC6H5	-	-	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-	-	-
	MIBK	-	-	-	-	-	-	-	-	-	-	-
	TCLEE	-	-	-	-	-	-	-	-	-	-	-
	TRGLE	-	-	-	-	-	-	-	-	-	-	-
	TXYLEN	-	-	-	-	-	-	-	-	-	-	-
	XYLEN	-	-	-	-	-	-	-	-	-	-	-
	2MNA	-	-	-	-	-	-	-	-	-	-	-
	24DNT	-	-	-	-	-	-	-	-	-	-	-
	26DNT	-	-	-	-	-	-	-	-	-	-	-
	35DNA	-	-	-	-	-	-	-	-	-	-	-
	ANAPYL	-	-	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-	-	-
	BBFANT	-	-	-	-	-	-	-	-	-	-	-
	BGHIPY	-	-	-	-	-	-	-	-	-	-	-
	BKFANT	-	-	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-	-	-
	DNBP	-	-	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-	-	-
	NAP	-	-	-	-	-	-	-	-	-	-	-
	NBUETH	-	-	-	-	-	-	-	-	-	-	-
	NNDPA	-	-	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-	-	-
	PYR	-	-	-	-	-	-	-	-	-	-	-
	AG	-	-	-	-	-	-	-	-	-	-	-
	AL	-	-	-	-	-	-	-	-	-	-	-
	AS	-	-	-	-	-	-	-	-	-	-	-
	BA	-	-	-	-	-	-	-	-	-	-	-
	BE	-	-	-	-	-	-	-	-	-	-	-
	CA	-	-	-	-	-	-	-	-	-	-	-
	CD	-	-	-	-	-	-	-	-	-	-	-
	CO	-	-	-	-	-	-	-	-	-	-	-
	CR	-	-	-	-	-	-	-	-	-	-	-
	CU	-	-	-	-	-	-	-	-	-	-	-
	FE	-	-	-	-	-	-	-	-	-	-	-
	HG	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-	-
	MG	-	-	-	-	-	-	-	-	-	-	-
	MN	-	-	-	-	-	-	-	-	-	-	-
	NA	-	-	-	-	-	-	-	-	-	-	-
	NI	-	-	-	-	-	-	-	-	-	-	-
	PB	-	-	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-	-	-
	TL	-	-	-	-	-	-	-	-	-	-	-
	V	-	-	-	-	-	-	-	-	-	-	-
	ZN	-	-	-	-	-	-	-	-	-	-	-
	NIT	-	-	-	-	-	-	-	-	-	-	-
	SO4	-	-	-	-	-	-	-	-	-	-	-
	pH(1)	-	-	-	-	-	-	-	-	-	-	-
	Alkyls	-	-	-	-	-	-	-	-	-	-	-
	Indicator	-	-	-	-	-	-	-	-	-	-	-
	parameter	-	-	-	-	-	-	-	-	-	-	-

as and flagging codes are presented at the end of this table.



**TABLE 6-16**  
**SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

Sic ID: Sample Type: UNITS: DATE SAMPLED: DEPTH	PBB-91-05		PBB-91-05		PBB-91-05		PBB-91-05		PBB-91-05		PBB-91-05		PBB-91-05		PBB-91-05	
	BORE UGG 10/14/91 31,000	BORE UGG 10/14/91 41,000	BORE UGG 10/14/91 51,000	BORE UGG 10/14/91 61,000	BORE UGG 10/14/91 71,000	BORE UGG 10/14/91 81,000	BORE UGG 10/14/91 91,000	BORE UGG 10/14/91 101,000	BORE UGG 10/14/91 111,000	BORE UGG 10/13/91 6,000						
VOCs																
111TCE	-	-	-	-	-	-	-	-	-	-						
12DCE	-	-	-	-	-	-	-	-	-	-						
13DMB	0.434	-	-	-	-	-	-	-	-	-						
4E2MHX	-	-	-	-	-	-	-	-	-	-						
ACET	-	-	-	-	-	-	-	-	-	-						
C6H6	-	-	-	-	-	-	-	-	-	-						
CCL4	-	-	-	-	-	-	-	-	-	-						
CH2CL2	-	-	-	-	-	-	-	-	-	-						
ETC6H5	-	-	-	-	-	-	-	-	-	-						
MEC6H5	-	-	-	-	-	-	-	-	-	-						
MEK	-	-	-	-	-	-	-	-	-	-						
MIBK	-	-	-	-	-	-	-	-	-	-						
TCLFEE	-	-	-	-	-	-	-	-	-	-						
TRCLE	-	-	-	-	-	-	-	-	-	-						
TXYLEN	-	-	-	-	-	-	-	-	-	-						
XYLEN	-	-	-	-	-	-	-	-	-	-						
SVOCs																
24DNT	3100.000	-	-	-	5.520	5.550	-	-	-	-						
26DNT	-	-	-	-	1.480	-	-	-	-	-						
35DNA	-	-	-	-	5.470	-	-	-	-	-						
ANAPYL	-	-	-	-	-	-	-	-	-	-						
B2EHP	-	-	-	-	-	-	-	-	-	-						
BAANTR	-	-	-	-	-	-	-	-	-	-						
BBFANT	-	-	-	-	-	-	-	-	-	-						
BGHPY	-	-	-	-	-	-	-	-	-	-						
BKFANT	-	-	-	-	-	-	-	-	-	-						
CHRY	-	-	-	-	-	-	-	-	-	-						
DNBP	-	-	-	-	-	-	-	-	-	-						
FANT	-	-	-	-	-	-	-	-	-	-						
NAP	-	-	-	-	-	-	-	-	-	-						
NBUETH	-	-	-	-	-	-	-	-	-	-						
NNDPA	-	-	-	-	0.769	0.113	-	-	-	-						
PHANTR	-	-	-	-	-	-	-	-	-	-						
Metals																
AL	-	-	-	-	-	-	-	-	-	-						
AS	-	-	-	-	-	-	-	-	-	4.550						
BA	-	-	-	-	-	-	-	-	-	0.594						
BE	-	-	-	-	-	-	-	-	-	-						
CA	-	-	-	-	-	-	-	-	-	-						
CD	-	-	-	-	-	-	-	-	-	-						
CO	-	-	-	-	-	-	-	-	-	-						
CR	2.480	3.170	3.470	2.430	1.880	14.100	3.340	3.210	19.300	11.500						
CU	-	-	5.650	-	-	-	-	-	-	-						
FE	-	-	-	-	-	-	-	-	-	-						
HG	-	-	-	-	-	-	-	-	-	-						
K	-	-	-	-	-	-	-	-	-	-						
MG	-	-	-	-	-	-	-	-	-	-						
MN	-	-	-	-	-	-	-	-	-	-						
NA	3.890	5.240	-	-	-	5.510	-	-	15.000	9.200						
NI	2.080	2.050	1.060	1.120	0.987	1.300	0.683	-	-	-						
PB	-	-	-	-	-	-	-	-	-	-						
SE	-	-	-	-	-	-	-	-	-	-						
TL	-	-	-	-	-	-	-	-	-	-						
V	-	-	6.740	4.640	-	-	-	-	2.920	43.300						
ZN	-	-	-	-	-	-	-	-	-	1.800						
Anions																
NIT	9.560	11.300	9.430	3.900	3.230	3.220	2.010	3.180	2.920	43.300						
SO4	5.890	14.000	23.100	36.000	36.400	33.600	-	-	21.100	-						
Indicator parameter																
pH(1)																

**Notes and flagging codes are presented at the end of this table.**



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBB-91-06 BORE UGG 10/13/91 12.000	PBB-91-06 BORE UGG 10/13/91 14.000	PBB-91-06 BORE UGG 10/13/91 16.000	PBB-91-06 BORE UGG 10/13/91 20.000	PBB-91-06 BORE UGG 10/13/91 22.000	PBB-91-06 BORE UGG 10/13/91 26.000	PBB-91-06 BORE UGG 10/13/91 31.000	PBB-91-06 BORE UGG 10/13/91 41.000	PBB-91-06 BORE UGG 10/13/91 51.000	PBB-91-06 BORE UGG 10/13/91 61.000
<b>VOCs</b>										
111TCE	-	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-
4E2MHX	8.360 S	-	-	-	-	-	-	-	-	-
ACET	37.200 S	864.000 S	441.000 S	114.000 S	179.000 S	114.000 S	51.900 S	166.000 S	86.600 S	51.600 S
C6H6	-	-	-	-	-	-	-	-	-	-
CCL4	0.825 S	-	-	0.887 S	-	-	-	0.883 S	0.969 S	-
CH2CL2	5.570 S	1.540 S	-	-	-	-	-	0.273 S	0.289 S	-
ETC6H5	2.670 S	14.400 S	4.010 S	0.845 S	1.100 S	0.686 S	0.560 S	1.640 S	1.150 S	0.619 S
MEC6H5	-	-	4.560 S	-	3.360 S	3.860 S	3.730 S	3.790 S	3.510 S	2.680 S
MEK	-	-	-	-	-	-	-	-	-	-
MIBK	4.990 S	-	-	-	-	-	-	-	-	-
TCLEE	1.140 S	-	-	-	-	-	-	-	-	-
TCLE	22.100 S	39.400 S	20.600 S	5.910 S	13.200 S	6.860 S	4.150 S	17.900 S	15.500 S	9.910 S
TXYLEN	39.500 S	11.500 S	5.510 S	0.971 S	0.380 S	0.322 S	0.353 S	1.770 S	1.710 S	1.610 S
<b>SVOCs</b>										
21NAP	18.200	69000.000	280000.000	21000.000	-	56000.000	8200.000	5700.000	4700.000	8500.000
24DNT	73000.000	-	-	-	-	-	-	1000.000	1000.000	830.000
26DNT	6.200 GT	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	6.200 GT	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBEANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
BKEANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	6.200 GT	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	6.200 GT	-	-	-	-	-	-	5.050 S	5.980 S	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	12.000 GT	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
AG	-	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	2.870	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	8.900	4.630	4.560	3.840	-	5.580	5.650	2.440	2.670	2.240
CU	106.000	19.600	9.650	13.200	-	7.060	6.250	4.760	-	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	6.070	4.270	18.000	1.140	-	11.000	1.090	1.260	2.020	1.080
PB	110.000	32.000	-	-	-	-	-	-	-	-
SE	1.770	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
<b>Anions</b>										
ZN	70.100	53.200	18.100	11.300	-	9.980	6.930	5.260	-	-
NIT	4.360	4.780	3.910	3.750	-	3.110	4.110	4.760	7.770	7.090
SO4	88.600	29.900	94.300	23.100	-	16.800	19.100	29.900	32.800	20.100
<b>Indicator parameter</b>										
pH(1)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBB-91-06	PBB-91-06	PBB-91-06	PBB-91-06	PBB-91-06	PBB-91-07	PBB-91-07	PBB-91-07	PBB-91-07	PBB-91-07
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/13/91	10/13/91	10/13/91	10/13/91	10/13/91	10/12/91	10/12/91	10/12/91	10/12/91	10/12/91
DEPTH:	71.000	91.000	101.000	111.000	141.000	6.000	8.000	10.000	12.000	16.000
VOCs										
11UTCE	-	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-
MIBK	-	-	-	-	-	-	-	-	-	-
TCLE	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
XYLEN	-	-	-	-	-	-	-	-	-	-
2MNAP	-	-	-	-	-	-	-	-	-	-
24DNT	1900.000	57.900	-	-	-	-	-	-	-	-
26DNT	160.000	11.900	-	-	-	-	-	-	-	-
3SDNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPT	-	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
Metals										
AL	-	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	2.200	5.760	2.030	4.200	-	10.900	26.000	5.810	4.310	-
CU	-	12.300	-	18.300	-	10.600	50.700	28.300	17.900	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-
PB	1.080	4.000	0.548	4.420	-	9.860	20.700	10.500	7.860	5.980
SE	-	1.800	-	1.040	-	4.820	2.550	3.400	2.340	1.910
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
ZN	-	6.240	-	11.600	-	14.100	61.200	15.300	10.000	-
Antious	5.160	2.750	1.860	1.030	-	1.160	1.560	1.160	1.120	1.330
SO4	70.600	22.900	7.260	-	-	150.000	60.200	41.600	31.600	49.300
Indicator										
parameter										
pH(1)										

Notes and flagging codes are presented at the end of this table.



TABLE 6-16

**Notes and flagging codes are presented at the end of this table.**

**Notes and flagging codes are presented at the end of this table.**



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBT-90-02 PIT UGG 09/05/90 3,000	PBT-90-03 PIT UGG 09/05/90 5,000	PBT-90-03 PIT UGG 09/05/90 10,000	PBT-90-03 PIT UGG 09/05/90 12,000	PBT-90-04 PIT UGG 09/05/90 4,000	PBT-90-05 PIT UGG 09/05/90 8,000	PBT-90-06 PIT UGG 09/06/90 4,000	PBT-90-06 PIT UGG 09/06/90 9,000	PBT-90-07 PIT UGG 09/06/90 1,000
VOCs									
1,1,1TCE	-	-	-	-	-	-	-	-	0.390
1,2DCE	-	-	-	-	-	-	-	-	-
1,1,2MBA	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-
MECAH5	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-
MIBK	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-
XYLEN	-	-	-	-	-	-	-	-	-
2MNA	-	-	-	-	-	-	-	-	-
SVOCs									
2,4DNT	-	-	-	-	-	12.282	-	6.127	-
2,6DNT	-	-	-	-	-	-	-	-	-
3,5DNA	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-
BANTR	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-
BRFANT	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-
Metals									
Ag	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-
CR	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-
ANIONS									
NIT	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-
Indicator parameter									
pH(1)	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: DEPTH:	PBT-90-07 PIT UGG 09/06/90 4.00	PBT-90-08 PIT UGG 09/06/90 5.00	PBT-90-08 PIT UGG 09/06/90 7.00	LOB-90-01 BORE UGG 08/21/90 0.00	LOB-90-01 BORE UGG 08/21/90 5.00	LOB-90-01 BORE UGG 08/21/90 10.00	LOB-90-01 BORE UGG 08/21/90 15.00	LOB-90-01 BORE UGG 08/21/90 20.00	LOB-90-01 BORE UGG 08/21/90 25.00
<b>VOCs</b>									
11TCE	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-
MIK	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-
<b>SVOCs</b>									
24DNT	-	-	-	-	-	-	-	-	-
28DNT	-	-	-	-	-	-	-	-	-
35DNT	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-
BAAATR	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-
BGHIPY	-	-	-	-	-	-	-	-	-
BKFANT	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-
<b>Metals</b>									
AG	-	-	-	-	-	-	-	-	-
AL	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-
CR	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-
<b>Anions</b>									
NIT	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-
<b>Indicator parameter</b>									
pH(1)	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	LOB-90-01	LOB-90-01	LOB-90-01	LOB-90-02	SPB-91-01	SPB-91-01	SPB-91-01	SPB-91-01	SPB-91-01	SPB-91-01
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	08/21/90	08/21/90	08/21/90	08/21/90	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91	10/14/91
DEPTH:	67,000	86,000	140,000	0,000	2,000	7,000	12,000	22,000	62,000	67,000
<b>VOCs</b>										
111TCE	-	-	-	-	-	-	-	-	-	-
12DCE	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-
4E2MHX	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	0.001 S
C6H6	-	-	-	-	-	-	-	-	-	-
CCl4	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-
ETC6H5	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	0.004 S
MIBK	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-
<b>SVOCs</b>										
2MNA	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
35DNA	-	-	-	-	-	-	-	-	-	-
ANAPYL	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BREANT	-	-	-	-	-	-	-	-	-	-
BHHPY	-	-	-	-	-	-	-	-	-	-
BKFAIT	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NAP	-	-	-	-	-	-	-	-	-	-
NBUETH	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
AL	-	-	-	-	-	-	-	-	-	-
AS	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	-	-	-	-	-
CR	-	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-
TL	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-
<b>Anions</b>										
7N	-	-	-	-	-	-	-	-	-	-
NIT	-	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-	-
<b>Indicator parameter</b>										
pH(1)	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 6-16  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOCs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
-	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RI Report Glossary.



**TABLE 6-17**  
**SUMMARY OF TCLP METALS DATA FOR SUBSURFACE SOIL -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

TCLP LEACHATE CONCENTRATION (µg/l)						
SAMPLE LOCATION	DEPTH	CD	CR	PB	HG	NOTES
TCLP RL <sup>1</sup>		1,000	5,000	5,000	200	
Minimum Reporting Value		6.8	16.8	43.4	0.1	
PBB-91-01	16	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-01	105	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-02	27	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-02	102	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-03	4	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-03	101	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-04	18	LT	LT	122	LT	TCLP RL not exceeded
PBB-91-04	72	LT	LT	95.2	LT	TCLP RL not exceeded
PBB-91-04	102	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-04	107	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-05	73	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-05	111	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-06	6	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-06	12	9.5	LT	1,460	LT	TCLP RL not exceeded
PBB-91-06	14	10.1	LT	167	LT	TCLP RL not exceeded
PBB-91-06	20	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-06	31	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-06	41	LT	22.8	LT	LT	TCLP RL not exceeded
PBB-91-06	61	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-06	91	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	6	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	8	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	10	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	12	LT	LT	LT	LT	TCLP RL not exceeded



continued

**TABLE 6-17**  
**SUMMARY OF TCLP METALS DATA FOR SUBSURFACE SOIL -**  
**PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )						NOTES
SAMPLE LOCATION	DEPTH	CD	CR	PB	HG	
PBB-91-07	20	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	32	LT	LT	LT	LT	TCLP RL not exceeded
PBB-91-07	62	LT	LT	LT	LT	TCLP RL not exceeded

**Notes:**

- <sup>1</sup> TCLP Regulatory Level (RLs) exist for the following metals: AS, BA, CD, CR, SE, PB, HG, and AG. However, these results were reported only for CD, CR, PB, and HG. (See List of USATHAMA Chemical Codes for definitions of chemical abbreviations).
- <sup>2</sup> LT - Less than the Minimum Reporting Value; corrected for percent moisture, dilution, and percent recovery.



**TAB: R 6-18**

## REMEDIAL INVESTIGATION

SAMPLE IDENTIFICATION AND DEPTH																			
ANALYTE	Settling Pond 1			Settling Pond 1			Settling Pond 2			Settling Pond 3			Settling Pond 4						
	S1201	Off.	15ft.	S1202	3ft.	15ft.	S1203	Off.	3ft.	16ft.	Off.	5ft.	19ft.	Off.	0.6ft.	15ft.	Off.	0.6ft.	15ft.
24DNT																			
AL	0.109	9750	681	LT 0.0099	172	17.1	0.27	14500	0.719	0.024	0.04	7.57	LT 0.0089	0.057	2.61	LT 0.0089	19000	LT 0.0089	LT 0.0089
DBP	LT 3.0	LT 3.0	LT 3.0	LT 3.0	10700	LT 3.0	LT 3.0	LT 3.0	LT 3.0	LT 3.0	3750	LT 3.0	LT 3.0	1750	LT 3.0	LT 3.0	LT 3.0	LT 3.0	LT 3.0
DEP	LT 4.0	LT 4.0	1340	LT 4.0	460	106	11		LT 4.0	LT 4.0	LT 4.0	135	LT 4.0	LT 4.0	44	LT 4.0	LT 4.0	LT 4.0	LT 4.0
NC																			
NO2	59900							336						0.17			1030		
NO3	7.15							LT 7.15			LT 7.15			LT 7.15			3.4		
NO3	0.889							LT 0.889			LT 0.889			LT 0.889			LT 0.889		
PB		100			45			180		30				20			165		
SN		0.45			2.8			1.2		4.7				3.9			1.1		
SO4	1370	344			661			56.2		20.2				15.1			183		

**USA THAMA IRDMIS**

1) LT - Less Than

- 1) LT - Less Than
- 2) All units are ug/g
- 3) Blank spaces indicate that the sample was not analyzed for the analyte.
- 4) Sample depths are likely incorrect; the Envirodyne Report indicates the
- 5) This table represents all available data contained in the IRDMIS for Site



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBM-82-01	PBM-82-02	PBM-82-03	PBM-82-04	PBM-82-05
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/25/91	04/10/92	11/25/91	04/11/92	04/11/92
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs	111TCE	-	-	28.5 P	-
	11DCE	-	-	-	-
	11DCL	-	-	-	-
	13DMB	-	-	-	-
	ACET	-	-	-	-
	C6H6	-	-	-	-
	CCL4	3.63	12.7	20.6	46.1
	CH2CL2	7.16 B	7.35 B	7.35 B	6.57 B
	CHCL3	3.22	2.11	1.01	4.83
	MEC6H5	-	-	-	-
	MEK	-	-	-	-
	TCLEE	-	-	-	-
SVOCs	TRCLE	0.786	63.7	11.7	38.2
	26DNT	-	-	42.5	51
	2BUXEL	-	-	-	-
	2E1HXL	-	-	-	-
	B2EHP	-	-	31.5 P	-
	BBZP	-	-	-	-
Metals	NNDPA	-	-	-	-
	BA	-	-	-	-
	BE	-	-	-	-
	CA	-	-	-	-
	CD	-	-	-	-
	CR	6.84	-	-	-
	CU	-	-	-	-
	FE	-	-	-	-
	HG	2.83	-	-	-
	K	-	-	-	-
	MG	-	-	-	-
	MN	-	-	-	-
	NA	-	-	-	-
Anions	PB	-	-	-	-
	V	-	-	-	-
	ZN	-	-	-	-
	NIT	5000	4200	3600	3600
	NO3	-	-	-	-
	CL	24000	25000 P	27000 X	26000 P
	SO4	30000	51000	39000	61000
	ALK	299000	298000	300000	322000
	HARD	352000	384000	354000	404000
	TDS	395000	401000	432000	488000
	pH(1)	7.4	7.4	7.6	7.8
	Sp.Cond.(2)	488	593	498	600
		574	602	554	626

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA--  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBM-85-01	PBM-85-02	PBM-85-03	PBM-85-04	PBM-85-05
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/21/91	04/25/92	11/21/91	04/14/92	04/12/92
ROUND:	ONE	TWO	ONE	TWO	TWO
VOCs					
111TCE	17.6	20.9	13.2	15.4	18.7
11DCE	-	-	-	-	-
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	51	69.6	66	73.5	51
CH2CL2	3.73 P	6.08 B	4.02 P	5.78 B	3.92 P
CHCL3	4.63	5.33	7.44	7.44	4.93
MEC6HS	-	-	-	-	-
MEK	-	-	-	-	-
TCLCE	-	-	-	-	-
TRCLE	35	44.6	66	74.3	36.1
SVOCs					
26DNT	-	-	-	1.28	-
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
BBZP	-	-	-	-	-
NNDFA	-	-	25	24	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	-	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	4500	5400	6300	6000	10000
NO3	27000 P	27000 P	31000 P	32000 P	25000 P
CL	70000	66000	61000	79000	55000
SO4	315000	300000	337000	342000	314000
Indicator	408000	420000	446000	443000	420000
parameter	476000	495000	487000	479000	451000
TDS	7.6	7.1	7.5	6.5	6.5
pH(1)	7.6	7.1	7.5	6.5	6.5
Sp.Cond.(2)	702	657	737	754	783
					778

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBM-85-06	PBM-89-05	PBM-89-06	PBM-89-07	PBM-89-08
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/06/91	04/14/92	11/09/91	04/24/92	04/12/92
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs					
111TCE	-	-	-	-	-
11DCE	-	-	-	-	-
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	-	16.7	52	-	8.2
CH2CL2	3.92 P	6.37 B	4.41 P	7.25 B	4.41 P
CHCL3	-	-	0.986	1.51	0.996
MEC6H5	-	-	-	-	-
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TRCLE	-	-	24	7.75	40
SVOCs					
26DNT	-	-	-	-	-
28UXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
BBZP	-	-	-	-	-
NNDPA	-	-	-	-	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	-	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	750	14000	10000	13000	14000
NO3	2200	23000	38000	35000	8600
CL	10000	26000 X	43000	17000	17000
SO4	22000	92000	43000	28000	42000
Indicator	ALK	276000	316000	252000	296000
parameter	HARD	297000	446000	326000	341000
TDS	387000	494000	509000	469000	391000
pH(1)	7.2	7.6	7.5	7.8	7.2
Sp.Cond.(2)	527	704	711	604	652

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBM-89-09	PBM-89-11	PBN-82-01A	PBN-82-01B	PBN-82-01C
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/23/91	04/22/92	11/06/91	12/04/91	04/09/92
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs					
111TCE	-	-	-	-	-
11DCE	-	-	-	-	-
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	-	-	9.8	12.7	3.8
CH2CL2	4.22 P	4.71 P	4.12 P	8.04 B	4.02 P
CHCL3	2.62	2.41	-	5.88 B	6.27 B
MEC6H5	-	-	0.513 P	-	3.12
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TRCLE	2.02	0.902	-	0.436 P	-
SVOCs					
26DNT	-	-	25.5	57.3	20
28UXEL	-	-	-	0.637	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
B8ZP	-	-	-	-	-
NNDPA	-	-	-	-	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	-	-	46.6	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	10.5	-	-	-	-
ZN	-	-	-	-	-
Asbestos					
NTT	6000	5300	6000	4900	4300
NO3	-	-	-	-	-
CL	26000 P	29000 P	10000	32000 P	35000
SO4	30000	32000	21000	28000	30000
Indicator	256000	306000	294000	242000	285000
ALK	354000	340000	314000	366000	308000
HARD	396000	356000	436000	352000	340000
TDS	7.4	7.7	7.3	7.3	7.5
pH(1)	5.36	6.11	5.81	6.9	7.3
Sp.Cond.(2)	536	611	581	667	655
					639
					646

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-82-02A	PBN-82-02B	PBN-82-02C	PBN-82-03A	PBN-82-03B
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/04/91	04/08/92	12/05/91	04/09/92	04/09/92
ROUND:	ONE	TWO	ONE	TWO	TWO
VOCs					
111TCE	-	-	-	6.37	-
11DCE	-	-	-	-	-
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	11.8	14.7	13.7	53.9	11.8
CH2CL2	5.39	6.86 B	5.88 B	5.49 B	4.41 P
C4CL3	3.92	-	0.694 P	5.63	1.31
MEC6H5	-	-	-	-	-
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TCLE	84.9	99.8	98.7	5.4	7.9
SVOCs					
26DNT	-	-	-	-	-
28UXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	35 P	52.5 P	-	65.3
B8ZP	-	-	-	-	-
NNDPA	-	-	-	-	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	13.7	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	6400	5700	6300	5800	2700
NO3	30000 P	27000 P	30000 P	32000 P	21000
CL	32000	33000	36000	39000	30000
SO4	310000	315000	312000	232000	292000
Indicator	ALK	310000	312000	244000	287000
parameter	HARD	394000	384000	344000	334000
TDS	429000	441000	456000	395000	407000
pH(1)	7.4	6.0	7.4	6.5	7.3
SpCond(2)	817	631	617	569	517

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-82-03C	PBN-82-04A	PBN-82-04B	PBN-82-04C	PBN-82-05A
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/24/91	12/07/91	11/22/91	11/22/91	04/13/92
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs					
111TCE	-	5.6	-	-	43.9
11DCE	-	-	-	-	-
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	2.55 P	30.4	2.0 P	1.76 P	73.5
CH2CL2	4.02 P	6.57 B	4.12 P	2.4 P	92.2
CHCL3	1.01	4.63	4.73	3.82 P	6.08 B
MEC6H5	-	-	-	5.03	5.23
MEK	-	-	-	-	-
TCLFE	-	-	-	-	-
TRCLE	-	13.8	4.1	4.7	64.8
26DNT	-	-	-	-	0.839 P
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	28.0 P	-	28.7 P	105
BBZP	-	-	-	-	16.0 S
NNDPA	-	-	-	-	18.3
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	-	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	3600	5600	4000	4300	7900
NO3	-	-	-	-	-
CL	35000	26000 P	37000	36000	24000 X
SO4	42000	52000	42000	41000	60000
Indicator	314000	314000	280000	283000	332000
parameter	400000	382000	370000	368000	396000
HARD	440000	408000	407000	401000	422000
TDS	7.7	7.3	7.6	7.5	8.1
pH(1)	627	709	608	604	60
Sp.Cond (2)	-	-	-	-	717

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-82-05B	PBN-82-05C	PBN-85-01A	PBN-85-02A	PBN-85-03A
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/05/91	12/06/91	11/10/91	11/21/91	11/13/91
ROUND:	ONE	ONE	ONE	ONE	ONE
	04/13/92	04/13/92	04/24/92	04/23/92	04/25/92
	TWO	TWO	TWO	TWO	TWO
VOCs					
11ITCE	-	-	16.5	19.8	3.62 P
11DCE	-	-	-	-	59.3
11DCLE	-	-	1.4	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCl4	7.75	5.78	30	39.2	76
CH2CL2	5.59	3.14 P	4.9 P	7.75 B	4.22 P
CHCL3	4.02	4.63	83.5	7.85	7.65 B
MEC6H5	-	-	-	-	2.82
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TRCLE	53.1	32.9	28	36.1	31.8
26DNT	1.1 P	-	-	-	20
26UXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	47.8 P	74.8	-	-	-
BBZP	-	-	-	-	-
NNDPA	4.52	2.25	2.46	0.955	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	11	-	10.7	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	6400	5500	3000	5100	16000
NO3	-	-	-	-	-
CL	37000	35000	29000 P	31000 P	25000 P
SO4	140000	69000	68000	54000	36000
Indicator					
ALK	276000	254000	304000	308000	268000
HARD	394000	384000	426000	400000	458000
TDS	517000	481000	473000	433000	484000
pH(1)	7.6	6.0	6.0	7.3	7.5
Sp.Cond.(2)	984	733	714	349	602
					588
					14000
					21000
					31000
					278000
					370000
					392000
					7.4
					560

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: ROUND:	PBN-85-04A WELL UGL	11/08/91 ONE	04/12/92 TWO	11/10/91 ONE	04/24/92 TWO	11/12/91 ONE	04/24/92 TWO	12/08/91 ONE	04/24/92 TWO	PBN-89-01D WELL UGL	11/21/91 ONE	04/23/92 TWO
VOCs												
111TCE	-	-	-	-	-	59.3	3.73 P	-	-	-	-	-
11DCE	-	-	0.655 P	-	-	-	-	-	-	-	-	-
11DCL2	-	-	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	2.6 S	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-	-	-
CCL4	6.2	-	12.7	6.4	7.75	15	7.35	-	1.86 P	-	30	14.7
CH2CL2	3.73 P	-	3.14 P	4.51 P	6.76 B	4.9 P	6.96 B	5.2 P	7.94 B	-	4.22 P	8.33 B
CHCL3	1.31	-	2.11	35.2	3.22	4.43	5.33	5.73	4.63	-	3.72	2.82
MECHS	-	-	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	1.78	-	-	-	-	-	-	-	-	-
TCLEE	-	-	11.7	92	14.9	28	44.6	0.488 P	2.12	-	22	11.7
SVOCs												
26DNT	-	-	-	-	-	-	-	-	-	-	-	-
28UXEL	-	-	-	-	-	-	-	-	-	-	-	-
2E1HXL	-	-	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-	-	-
BBZP	-	-	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	2.93	-	-	-	3.6	-	-	-	-	-
Metals												
BA	-	-	-	-	-	-	-	-	-	-	-	-
BE	-	-	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-	-
CR	9.73	-	-	-	-	8.14	-	6.32	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-	-	-
PB	11.1	-	-	6.83	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-	-	-	-
Anions												
NIT	11000 X	14000	4300	5000	4800	5300	5000	6700	5000	8100	7600	
NO3	-	-	-	-	-	-	-	-	-	-	-	-
CL	24000	24000	33000	38000	33000	37000	26000 P	26000 P	26000 P	27000 X	25000 P	
SO4	-	51000	59000	130000	78000	75000	37000	37000	39000	47000	49000	
Indicator	ALK	299000	330000	277000	296000	296000	286000	350000	296000	320000	277000	
parameter	HARD	396000	416000	392000	386000	414000	436000	296000	357000	410000	400000	
TDS	513000	424000	423000	408000	408000	488000	404000	348000	381000	40000	447000	
pH(1)	7.2	6.0	7.1	7.2	7.5	7.2	7.5	8.4	7.5	7.7	7.5	
Sp.Cond.(2)	726	713	701	339	672	357	320	688	320	682	550	

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-89-03C	PBN-89-03B	PBN-89-03C	PBN-89-04B	PBN-89-04B
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/21/91	04/23/92	11/09/91	04/25/92	11/08/91
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs					
111TCE	-	-	-	-	2.85 P
11DCE	-	-	-	-	2.41 P
11DCLE	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CCL4	12	13.7	21	29.4	35
CH2CL2	4.22 P	7.45 B	4.41 P	6.37 B	3.92 P
CHCL3	2.52	1.81	1.61	-	6.04
MECAHS	-	-	-	-	-
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TRCLE	11	11.7	2	1.91	51
SVOCs					
26DNT	-	-	-	-	1.39
26UXEL	-	-	-	-	0.976 P
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
BBZP	-	-	-	-	-
NNDPA	-	-	-	-	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	-	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	7000	7400	4300	4800	5900
NO3	25000 P	25000 P	26000 P	27000 P	26000 P
CL	45000	48000	47000	44000	67000
SO4	312000	286000	300000	324000	326000
Indicator	396000	396000	374000	396000	408000
parameter	417000	424000	419000	423000	529000
TDS	7.5	7.2	7.2	7.3	7.4
pH(1)	6.59	5.37	6.52	6.03	7.57
Sp.Cond.(2)	740	667	752	655	740

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA--  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: ROUND:	PBN-89-04C WELL UGL	10/24/90 II	11/09/91 ONE	04/13/92 TWO	PBN-89-04C WELL UGL	12/05/91 ONE	04/10/92 TWO	PBN-89-10A WELL UGL	12/06/91 ONE	04/26/92 TWO	PBN-89-10B WELL UGL	12/13/91 ONE	04/26/92 TWO
<b>VOCs</b>													
111TCE			2.52 P	2.31 P									
11DCE			-	-									
11DCLE			-	-									
13DMB			-	-									
ACET			-	-									
C6H6			-	-									
CCL4			36	27.5		22.5	30.4			2.45 P			
CH2CL2	20.5	58.6	4.31 P	6.37 B		-	7.75 B		4.12 P	6.76 B		3.53 P	6.96 B
CHCL3	3.24	6.89	6.64	5.03		2.82	1.81		3.22	2.52		1.21	3.12
MEC6H5			-	-		-	-		-	-		-	-
MEK			-	-		-	-		-	-		-	-
TCLEE			-	-		-	-		-	-		-	-
TRCLE	28.5	67.4	49	41.4		79.6	97.7		2.34	0.626		1.17	-
<b>SVOCs</b>													
24DNT			-	-		-	-		-	-		-	-
28UXEL												5.0 S	
2E1HXL												60 S	
B2EHP						28.7 P	-		57.3	-		119	382
BBZP						-	-		-	-		-	-
NNDPA				10		-	-		-	-		-	-
<b>Metals</b>													
BA													
BE													
CA													
CD													
CR													
CU			8.61	-		7.73	-		8.32	-		9.79	-
FE													
HG							4.31						
K													
MG													
MN													
NA													
PB													
V			5.9	-		-	-		-	-		-	-
ZN													
<b>Anions</b>													
NIT			5800	4900		5100	4900		1700	5200		8100	5200
NO3			24000 P	27000 P		32000 P	32000 P		27000 P	26000 P		29000 P	26000 P
CL			68000	58000		26000	27000		42000	45000		41000	43000
SO4			316000	342000		328000	356000		250000	256000		254000	276000
<b>Indicator</b>													
ALK			406000	428000		380000	444000		364000	354000		328000	348000
<b>parameter</b>			455000	452000		447000	449000		420000	409000		576000	393000
<b>TDS</b>			7.4	7.5		7.2	6.5		7.5	7.2		7.3	7.2
pH(1)			772	573		633	672		639	565		423	562
Sp.Cond.(2)													

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA--  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-89-10D	PBN-89-12A	PBN-89-12B	PBN-91-06C	PBN-91-12A
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/12/91	04/29/92	11/05/91	04/29/92	04/29/92
ROUND:	ONE	TWO	ONE	TWO	TWO
VOCs					
111TCE	-	-	-	-	-
11DCE	-	-	-	-	-
11DCL	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	17 S	-	-
C6H6	-	-	-	-	-
CCL4	-	-	26	-	-
CH2CL2	4.22 P	6.96 B	3.92 P	6.67 B	6.76 B
CHCL3	-	-	4.73	-	-
MEC6HS	-	-	4.81 P	-	-
MEK	-	-	-	-	-
TCLEE	-	-	-	-	-
TRCLE	0.91	1.8	18	0.998	-
SVOCs					
26DNT	-	-	-	-	-
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
BBZP	-	-	-	-	-
NNDFPA	-	-	-	-	-
Metals					
BA	-	-	-	-	-
BE	-	-	-	-	-
CA	-	-	-	-	-
CD	-	-	10.1	8.27	12.4
CR	9.02	-	-	-	-
CU	-	-	-	-	-
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	-	-	-
Zn	-	-	-	-	-
Asilos					
NIT	-	1000	5700	140	-
NO3	-	21000	24000	7700	7000
CL	6700	7600	20000	91000	100000
SO4	99000	99000	60000	99000	100000
Indicator					
ALK	269000	270000	299000	304000	280000
HARD	364000	376000	390000	398000	380000
TDS	431000	391000	513000	407000	399000
pH(1)	7.5	7.6	7.2	7.8	7.7
Sp.Cond.(2)	562	548	719	706	625

Notes and flagging codes are presented at the end of this table.



**TABLE 6-19**  
**SUMMARY OF GROUNDWATER CHEMICAL DATA--**  
**PROPELLANT BURNING GROUND/LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

Site ID:	PBN-91-12C	PBN-91-12D	LOM-89-01	LOM-91-01
Sample Type:	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/04/91	04/29/92	11/23/91	04/10/92
ROUND:	ONE	TWO	ONE	TWO
<b>VOCs</b>				
111TCE	-	-	-	-
11DCE	-	-	-	-
11DCL	-	-	-	-
13DMB	-	-	-	-
ACET	-	-	-	-
C6H6	-	-	-	-
CCL4	34.3	19.6	10.8	35.3
CH2CL2	5.1 P	7.25 B	4.22 P	7.75 B
CHCL3	7.24	3.02	1.81	0.956
MEC6H5	-	-	-	-
MEK	-	-	-	-
TCLEE	-	-	-	-
TRCLE	24.4	9.45	0.881	1.91
26DNT	-	-	-	-
26UXEL	-	-	-	-
2E1HXL	-	-	-	-
B2EHP	28.0 P	41.4 P	-	78
BBZP	-	-	-	-
NNDPA	2.19	1.53	-	-
<b>Metals</b>				
BA	-	-	61	41.9 X
BE	-	-	-	-
CA	-	-	91000	90000
CD	-	-	-	-
CR	-	-	9.99	11.1
CU	24.0	38.8	5.18	5.22
FE	-	-	74.8	37
HG	-	-	-	-
K	-	-	1380 T	2650 T
MG	-	-	50000	47000
MN	-	-	-	-
NA	-	-	-	22000 T
PB	-	-	-	-
V	-	-	-	-
ZN	-	-	87.6	-
<b>Anions</b>				
NTT	5800	5600	3300	1900
NO3	-	-	-	-
CL	21000	24000	10000	12000
SO4	53000	61000 X	77000	82000
<b>Indicator parameter</b>				
ALK	354000	310000	256000	326000
HARD	408000	416000	366000	414000
TDS	421000	404000	455000	436000
pH(1)	7.8	7.4	7.9	7.4
Sp.Cond.(2)	638	592	660	595
			645	646
				4900
				23000
				289000
				370000
				491000
				405000
				7.7
				7.5
				635

Notes and flagging codes are presented at the end of this table.



**TABLE 6-19**  
**SUMMARY OF GROUNDWATER CHEMICAL DATA -**  
**PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

Site ID:	LOM-91-02				LOM-89-02A				LOM-89-02B				LOM-89-03A				LOM-89-03B			
Sample Type:	WELL		WELL		WELL		WELL		WELL		WELL		WELL		WELL		WELL			
UNITS:	UGL		UGL		UGL		UGL		UGL		UGL		UGL		UGL		UGL			
DATE SAMPLED:	12/13/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92	12/07/91	04/22/92		
ROUND:	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO		
VOCs																				
111TCE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11DCE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11DCLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13DMB	2.7 S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
ACET	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
C6H6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CCL4	-	-	24.5	25.5	2.25 P	2.16 P	24.5	19.6	2.06 P	19.6	2.06 P	19.6	2.06 P	19.6	2.06 P	2.06 P	2.06 P	2.06 P		
CH2CL2	4.12 P	6.08 B	5.29	5.98 B	5.0 P	5.39 B	5.1 P	5.69 B	5.1 P	5.69 B	5.1 P	5.69 B	5.1 P	5.69 B	5.1 P	5.69 B	5.1 P	5.69 B		
CHCL3	0.543 P	0.9% P	1.51	1.11	-	2.11	1.31	0.503 P	-	0.503 P	-	0.503 P	-	0.503 P	-	0.503 P	-	0.503 P		
MEC6H5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
MEK	12 S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TCLEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TRCLE	-	-	53.1	34	3.61	-	28.7	17	2.44	-	-	-	-	-	-	-	-	-		
SVOCs																				
26DNT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
28UXEL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2E1HXL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
B2EHP	159	100	-	-	11 S	92	-	-	-	-	-	-	-	-	-	-	10 S	217		
BBZP	-	-	-	-	17S	-	-	-	-	-	-	-	-	-	-	-	191 P	-		
NNDPA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Metals																				
BA	43	37.3	63	72	37.8	39.9 X	53	44.9 X	49	-	-	-	-	-	-	-	-	63		
BE	-	-	-	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CA	85000	84000	97000	93000	96000	98000	91000	93000	120000 X	-	-	-	-	-	-	-	-	110000		
CD	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CR	8.23	-	6.62	-	8.48	-	8.8	-	8.36	-	-	-	-	-	-	-	-	65.03		
CU	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
FE	33.8	-	44.8	-	32.6	-	-	-	27	-	-	-	-	-	-	-	-	-		
HG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
K	1160 T	1190 T	1440 T	1350 T	1170 T	1450 T	1280 T	1540 T	1320 T	-	-	-	-	-	-	-	-	1640 T		
MG	48000	43000	55000 X	50000	54000	50000	46000	47000	50000 GT	-	-	-	-	-	-	-	-	57000 X		
MN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
NA	-	16000 T	23000 T	19000 T	-	14000 T	-	25000 T	-	-	-	-	-	-	-	-	-	16000 T		
PB	-	-	5.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V	-	12.1	-	-	-	15.6	-	-	-	-	-	-	-	-	-	-	-	18.5		
ZN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Anions																				
NIT	7200	5800	7100	5700	16000	13000	8500	6900	21000	-	-	-	-	-	-	-	-	18000		
NO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
CL	23000 P	25000 P	73000	56000	25000 P	27000 P	42000	42000	25000 X	-	-	-	-	-	-	-	-	27000 X		
SO4	52000	58000 X	85000	69000	76000	77000	45000	47000	86000	-	-	-	-	-	-	-	-	88000		
Indicator																				
ALK	294000	288000	254000	319000	280000	319000	302000	481000	223000	-	-	-	-	-	-	-	-	290000		
Hard	398000	382000	480000	446000	430000	442000	358000	441000	468000	-	-	-	-	-	-	-	-	468000		
TDS	419000	413000	552000	496000	503000	473000	455000	460000	535000	-	-	-	-	-	-	-	-	436000		
pH(1)	7.4	7.6	7.1	7.15	7.5	7.2	7.5	7.2	7.6	-	-	-	-	-	-	-	-	-		
SeCond(2)	475	652	596	715	516	682	504	670	560	-	-	-	-	-	-	-	-	814		

**Notes and flagging codes are presented at the end of this table.**



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	SPN-89-01C	SPN-89-02A	SPN-89-02B	SPN-89-02C	SPN-89-03B
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/10/91	04/23/92	11/19/91	04/28/92	10/24/90
ROUND:	ONE	TWO	ONE	TWO	I
VOCs					
13DMB	3.6 S	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	-	4.5	21.6	23.5
CH2CL2	4.41 P	7.55 B	4.61 P	7.35 B	7.45 B
CHCL3	0.755 P	0.966	0.996	1.01	1.61
MEK	-	-	-	-	-
TRCLE	-	-	-	-	-
SVOCs					
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	30.3 P	-	43.8 P	-	49 P
BA	32.5	33.6	34.2	33.1	32.5
BE	-	-	-	0.357	-
CA	77000	85000	130000	84000	58000
CD	-	-	-	-	-
CR	7.63	-	11.8	-	-
CU	4.99	10.1	23.1	-	-
FE	27.9	26.6	29.5	5.52	7.6
K	992 T	1470 T	755 T	1650 T	21000 T
MG	38000	39000	48000	44000	38000
MIN	-	-	-	-	-
NA	-	16000 T	-	11000 T	24000 T
NI	-	9.28	-	-	-
PB	-	-	-	13.6	7.02
V	-	19.1	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	15000	9200	8300	9900	9600
CL	21000	24000	74000	19000	19000
SO4	41000	42000	62000	43000	42000
Indicator					
ALK	262000	247000	397000	292000	300000
HARD	308000	362000	508000	378000	276000
TDS	411000	375000	621000	409000	400000
pH(1)	7.5	7.6	7.2	7.6	7.4
SpCond(2)	641	621	1002	568	657
			644	656	7.5
					7.7
					515

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type:	SPN-89-03B WELL UGL	12/10/91 ONE	04/27/92 TWO	09/26/90 I	10/24/90 II	11/20/91 ONE	04/27/92 TWO	SPN-89-03C WELL UGL	11/20/91 ONE	04/27/92 TWO	SPN-89-04B WELL UGL	11/20/91 ONE	04/27/92 TWO	12/13/91 ONE	04/27/92 TWO	SPN-89-04C WELL UGL
<b>VOCs</b>																
13DMB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ACET	65 S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCl4	46.1	71.6	7.35 B	167	155	97	89.2	3.53 P	24	8.43	16.7	3.53 P	6.76 B	16.7	6.76 B	16.7
CH2CL2	5.2 P	7.35 B	6.04	13.3	9.78	7.85	8.25	3.52	3.92 P	6.96 B	3.52	2.82	3.82	3.82	3.82	3.82
CHCL3	5.13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRCLE	1.59	2.44	2.22	1.96	0.95	0.95	0.892	4.7	2.44	2.23	7.7 S	2.23	2.12	2.12	2.12	2.12
<b>SVOCs</b>																
2BUXEL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2E1HXL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>																
BA	223	51	31.4	39	66.9	39	40.4 X	175	44 X	36.6	41.6 X	36.6	41.6 X	36.6	41.6 X	41.6 X
BE	30.8	0.376	77000	84000	78000	84000	78000	98000	81000	89000	89000	89000	89000	89000	89000	89000
CA	79000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	8.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	799 T	1480 T	41000	920 T	1500 T	980 T	2160 T	41000	980 T	2160 T	41000	980 T	2160 T	41000	980 T	1550 T
MG	43000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Anions</b>																
NIT	7500	6300	17000	18000	8000	6600	8000	7900	20000	36000	20000	20000	36000	20000	21000	9000
CL	15000	17000	50000	53000	19000	18000	57000 X	47000	20000	36000	20000	20000	36000	20000	21000	9000
SO4	50000	23000	30000	30000	26000	292000	26000	336000	336000	298000	336000	336000	298000	336000	336000	336000
<b>Indicator parameter</b>																
ALK	266000	347000	368000	374000	384000	374000	384000	430000	430000	386000	430000	430000	386000	430000	430000	430000
HARD	395000	304000	304000	415000	411000	415000	411000	455000	455000	440000	455000	455000	440000	455000	455000	455000
TDS	7.5	7.3	7.3	7.5	7.6	7.4	7.4	7.2	7.2	7.4	7.4	7.2	7.4	7.4	7.4	7.4
pH(1)	6.31	5.57	5.57	6.86	5.31	6.43	6.00	7.06	7.06	6.32	7.06	7.06	6.32	7.06	7.06	7.06
Sp.Cond.(2)	631	557	557	686	531	643	600	605	605	632	605	605	632	605	605	605

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	SPN-89-05A			SPN-89-05B			SPN-91-02D			SPN-91-03D			SPN-91-04D		
Sample Type:	WELL			WELL			WELL			WELL			WELL		
UNITS:	UGL			UGL			UGL			UGL			UGL		
DATE SAMPLED:	11/23/91	04/24/92	11/23/91	04/24/92	12/13/91	04/29/92	12/13/91	04/29/92	12/10/91	04/29/92	12/13/91	04/29/92	12/13/91	04/29/92	04/29/92
ROUND:	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	TWO
VOCs															
13DMB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CCLA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	4.22 P	6.76 B	4.51 P	7.55 B	3.33 P	3.14 P	11.8	28.4	5.0 P	6.67 B	3.33 P	6.96 B	3.33 P	6.96 B	6.96 B
CHCL3	-	-	1.01	-	-	2.92	1.31	2.52	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs															
2BUXEL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2E1HXL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals															
BA	39.5 X	33	33.8	36.9	20 S	81.2	175 X	87.6	25.4	29.9	92.4	35 P	92.4	35 P	98
BE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CA	92000	78000	76000	81000	-	0.374	84000	89000	84000	89000	70000	68000	70000	68000	68000
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	9.66	-	10.3	-	7.28	-	-	-	-	-	-	-	-	-	-
CU	4.87	-	5.88	-	-	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	1000 T	1170 T	1320 T	1600 T	811 T	1980 T	956 T	2040 T	956 T	2040 T	769 T	2000 T	769 T	2000 T	34.4
MG	25000	23000	32000	34000	-	41000	43000	42000	43000	42000	35000	34000	35000	34000	34000
MN	1000	700	-	-	-	-	-	-	-	-	-	570	-	570	570
NA	-	14000 T	3000 T	6900 T	3110 T	13000 T	-	11000 T	-	11000 T	2610 T	12000 T	-	12000 T	12000 T
NI	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZN	162	-	238 X	-	-	-	-	-	-	-	-	-	-	-	-
Anions															
NIT	560	1300	3400	4600	5400	4600	6500	5200	6500	5200	1100	-	1100	-	-
CL	12000	11000	10000	12000	9700	11000	11000	14000	11000	14000	6600	7600	6600	7600	7600
SO4	38000	39000	29000	30000	42000	44000	68000	70000	68000	70000	51000	53000 X	51000	53000 X	53000 X
Indicator															
ALK	267000	264000	260000	242000	256000	276000	268000	296000	268000	296000	278000	262000	278000	262000	262000
HARD	310000	298000	314000	318000	300000	356000	376000	400000	376000	400000	282000	320000	282000	320000	320000
TDS	345000	319000	327000	348000	369000	376000	425000	445000	425000	445000	472000	347000	472000	347000	347000
pH(1)	7.4	7.5	7.5	7.5	7.6	7.8	7.6	7.4	7.6	7.4	7.6	7.3	7.6	7.3	7.3
Sp Cond.(2)	494	490	456	535	389	584	664	578	664	578	445	466	445	466	466

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1101	S1102	S1103	S1104	S1105
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/11/91	04/24/92	11/20/91	12/13/91	04/23/92
ROUND:	ONE	TWO	ONE	TWO	TWO
VOCs					
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	-	8.9	-	-
CH2CL2	5.0 P	6.18 B	4.41 P	7.65 B	4.12 P
CHCL3	-	1.21	-	-	7.75 B
MEK	-	-	-	-	-
TRCLE	-	-	-	-	-
SVOCs					
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	-
Metals					
BA	35.3	36.7	41.2 X	33	56
BE	-	0.453	-	-	-
CA	100000	97000	99000	81000	85000
CD	-	-	-	3.61	-
CR	10.1	-	12.9	9.91	6.55
CU	4.89	-	5.82	-	-
FE	66.9	-	25.8	-	-
K	1280	1470 T	890 T	793 T	1470 T
MG	25000	24000	53000	31000	26000
MN	-	-	-	-	24
NA	19000 T	27000 T	-	2090 T	2870 T
NI	-	-	-	-	-
PB	-	-	-	-	-
V	-	-	5.01	-	-
ZN	-	-	320	-	-
Anions					
NIT	5100	6300	7100	4200	5100
CL	140000	27000 P	26000 X	2400 P	4800
SO4	21000	49000	52000	53000 X	33000
Indicator					
ALK	320000	320000	304000	309000	288000
HARD	380000	387000	380000	392000	326000
TDS	347000	451000	419000	427000	371000
pH(1)	7.3	7.3	7.2	7.4	7.3
SpCond(2)	916	538	672	592	516
					592

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1106	S1107	S1108	S1109	S1117
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	U/L	U/L	U/L	U/L	U/L
DATE SAMPLED:	12/13/91	04/25/92	12/13/91	04/22/92	04/11/92
ROUND:	ONE	TWO	ONE	TWO	TWO
VOCs					
111TCE	-	-	-	-	3.29 P
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	-	-	-	13.7
CH2CL2	4.22 P	7.16 B	4.61 P	7.65 B	4.61 P
CHCL3	-	0.915	-	-	2.52
MEK	-	-	-	-	-
TRCLE	-	-	-	-	11.7
SVOCs					
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	-	-
B2EHP	-	-	-	-	28.0 P
Metals					
BA	27	31.5 P	48	130	-
BE	-	33.1	-	0.348	53
CA	60000	71000	75000	82000	86000
CD	-	-	-	-	-
CR	7.36	-	6.23	4.93	7.8
CU	-	-	-	-	-
FE	-	-	-	-	6.91
K	793 T	1030 T	600 T	504	33.4
MG	29000	34000	31000	546 T	672 T
MN	-	-	-	12000	47000
NA	3280 T	12000 T	-	1700	-
NI	-	-	-	21000 T	11000 T
PB	-	-	-	-	-
V	-	-	-	12	19.0
ZN	-	-	-	-	-
Anions					
NIT	4800	4900	2900	-	3600
CL	14000	15000	32000 P	25000 P	38000
SO4	37000	28000	13000	60000 X	52000
Indicator					
ALK	205000	220000	260000	186000	306000
HARD	296000	296000	292000	276000	392000
TDS	321000	315000	343000	336000	444000
pH(1)	7.6	7.8	7.3	7.1	7.4
Sp.Cond.(2)	447	507	389	396	622
			314	474	605

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1133	S1146	S1147	S1148	S1149
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/10/91	04/12/92	11/20/91	04/24/92	12/13/91
ROUND:	ONE	TWO	ONE	TWO	ONE
					04/25/92
					TWO
<b>VOCs</b>					
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	35.3	-	-	-
CH2CL2	4.61 P	3.53 P	4.22 P	7.35 B	3.63 P
CHCL3	0.634 P	3.72	0.503 P	-	-
MEK	-	-	-	-	-
TRCLE	-	4.99	-	-	-
<b>SVOCs</b>					
2BUXEL	-	-	-	-	8.0 S
2E1HXL	-	49.4 P	-	-	-
B2EHP	-	-	-	-	-
<b>Metals</b>					
BA	31.4	33.8	24.1	30.4	35.3
BE	-	-	-	-	-
CA	74000	87000	67000	65000	82000
CD	3.43	-	-	-	-
CR	6.4	-	8.11	-	5.35
CU	-	6.91	7.68	-	6.47
FE	27.8	-	33.1	-	6.37
K	895 T	1340 T	1170 T	2060 T	1080 T
MG	34000	41000	35000	34000	1440 T
MN	-	-	-	-	34000
NA	-	14000 T	22000 T	78000 T	-
NI	-	-	-	-	16000 T
PB	-	-	8.49	-	-
V	-	16.6	-	-	11.8
ZN	-	-	-	-	-
<b>Anions</b>					
NT	11000 X	9200	6200	3800	4800
CL	20000	24000	27000 P	58000	38000
SO4	637000	39000	37000	43000	37000
ALK	259000	298000	258000	238000	224000
HARD	311000	356000	302000	312000	290000
TDS	385000	411000	377000	413000	322000
pH(1)	7.5	7.6	7.2	7.4	7.6
Sp.Cond.(2)	643	620	604	648	544
		512		753	589

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BAGBY AIR ARMY AMMUNITION PLANT

Site ID:	S1152A	S1152B
Sample Type:	WELL	WELL
UNITS:	UGL	UGL
DATE SAMPLED:	12/11/91	12/11/91
ROUND:	ONE	TWO
VOCs	13DMB 2.4 S	-
	ACET -	-
	CCLA -	-
	CH2CL2 4.51 P	5.98 B
	CHCL3 -	4.41 P
	MEK -	-
	TRCLE -	-
SVOCs	2BUXEL	-
	2E1HXL	-
	B2EHP 28 P	-
Metals	BA 75	54
	BE -	-
	CA 120000 X	110000
	CD -	-
	CR 7.19	7.39
	CU 8.32	7.51
	FE 127	53.4
	K 1250 T	1350 T
	MG 35000	28000
	MN 11.2	-
	NA -	18000 T
	NI -	-
	PB -	7.4
	V -	-
	ZN 1900	250
Amions	NIT 8400	6100
	CL 26000 P	31000 P
	SO4 51000	47000
Indicator	ALK 328000	284000
parameter	HARD 440000	370000
	TDS 487000	445000
	pH(1) 8.3	8.0
	Sp. Cond.(2) 798	741
		675

Notes and flagging codes are presented at the end of this table.



TABLE 6-19  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
PROPELLANT BURNING GROUND/ LANDFILL 1/ SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

.	-	Meter not functioning
..	-	Purged dry
(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOCs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
.	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RJ Report Glossary



TABLE 6-20  
CHEMICAL AND PHYSICAL PROPERTIES OF MAJOR ORGANIC CONTAMINANTS -  
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREAS<sup>a</sup>  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICALS	CAS#	MOLECULAR WEIGHT (g/mole)	DENSITY (g/ml)	WATER SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm-m <sup>3</sup> /mole)	K <sub>ow</sub> <sup>b</sup> (ml/g)	K <sub>ow</sub> <sup>c</sup> (ml/ml)
<u>Volatile Organic Compounds</u>								
C6H6	71-43-2	78	0.8786	1.75x10 <sup>3</sup>	95.2	5.58x10 <sup>-3</sup>	83	132
CCL4	56-23-5	154	1.594	7.57x10 <sup>2</sup>	90	2.41x10 <sup>-2</sup>	110	437
CHCL3	67-66-3	119	1.483	8.2x10 <sup>2</sup>	150.5	2.88x10 <sup>-3</sup>	44	91
111TCE	71-55-6	133	1.32	1.50x10 <sup>3</sup>	123	1.44x10 <sup>-2</sup>	152	316
TRC/F	79-01-6	132	1.45	1.10x10 <sup>3</sup>	57.9	9.10x10 <sup>-3</sup>	126	240
XYLEN	1330-20-7	106		1.98x10 <sup>2</sup>	10	7.04x10 <sup>-3</sup>	240	1.82x10 <sup>3</sup>
(ortho)	95-47-6	106	0.88	1.75x10 <sup>2</sup>	10			8.91x10 <sup>2</sup>
(meta)	108-38-3	106	0.864	1.30x10 <sup>2</sup>	10			1.82x10 <sup>3</sup>
(para)	106-42-3	106	0.86	1.98x10 <sup>2</sup>	10			1.41x10 <sup>3</sup>
<u>Semivolatile Organic Compounds</u>								
24DNT	121-14-2	182	1.32 (CRC)	2.40x10 <sup>2</sup>	5.10x10 <sup>-3</sup>	5.09x10 <sup>-8</sup>	45/250 (HO)	1.29x10 <sup>5</sup>
26DNT	606-20-2	182	1.28 (CRC)	1.80x10 <sup>2</sup>	1.80x10 <sup>-2</sup>	3.27x10 <sup>-8</sup>	92	100
NNDPA	86-30-6	198	1.23 (CRC)	1.13x10 <sup>2</sup>	6.3Ex10 <sup>-4</sup>	1.4x10 <sup>-8</sup>	650 (ADL)	1.35x10 <sup>3</sup> (ADL)

**Notes:**

<sup>a</sup> All data from the Risk Assessment Guidance for Superfund (USEPA, 1989a) unless otherwise noted; ADL = Arthur D. Little, 1985; CRC = CRC Handbook of Chemistry and Physics (Weast, 1980-81); and HO = Ho, 1988.

<sup>b</sup> K<sub>ow</sub> = partition coefficient between the organic chemical and carbon.

<sup>c</sup> K<sub>ow</sub> = partition coefficient of the chemical between octanol and water.

See the List of USATHAMA Chemical Codes in the Glossary for definitions of chemical abbreviations.



**TABLE 6-21**  
**COMPOUNDS OF POTENTIAL CONCERN -**  
**PROPELLANT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION	
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	SUBSURFACE SOIL <sup>2</sup> ( $\mu\text{g/g}$ )
24DNT	10.7	58.9
26DNT	1	2
2MNAP	0.452	18.2
ANAPNE	-	16.9
ANAPLY	-	1.04
ANTRC	-	12.4
AS	9.45	18.8
B2EHP	6.2	6.2
BAANTR	0.204	8.9
BAPYR	-	3.55
BBFANT	-	3.91
BGHIPY	-	2.57
BKFANT	-	3.36
C6H6	0.42	9.09
CHRY	3.68	8.28
CR	49.8	40.4
CU	344	327.19
DBAHA	-	0.661
DBZFUR	-	5.8
DEP	6.2	6.2
DNBP	6.35	6.2
FANT	0.2	6.2
FLRENE	-	18.4
HG	0.334	-
ICDPYR	-	4.52
MEC6H5	-	14.4
NAP	-	6.2
NI	27.3	-
NIT	-	35
NNDPA	30.8	12
PB	2700	1200
PHANTR	1.32	12



continued

TABLE 6-21  
COMPOUNDS OF POTENTIAL CONCERN -  
PROPELLANT BURNING GROUND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION	
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	SUBSURFACE SOIL <sup>2</sup> ( $\mu\text{g/g}$ )
PYR	0.168	6.2
SE	0.618	1.77
SO4	-	280
TRCLE	-	0.23
TXLEN	-	39.5
ZN	1040	1253.94

Notes:

- = Not identified as a compound of potential concern.  
Exposure point concentrations is the 95th percentile concentration.  
 $\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm).

<sup>1</sup> Assessment of surface soil contamination was performed using samples PBS-91-01 through PBS-91-108. In addition, the upper portions of samples PBS-91-109 through PBS-91-114 were used to assess contamination of surface soil by 24DNT, 26DNT, C6H6, and CCL3F.

<sup>2</sup> Assessment of subsurface soil contamination from 0 to 12 feet was performed using data from the following borings, test pits, and surface soil samples: LOB-90-01, LOB-90-02, PBB-90-01, PBB-90-02, PBT-90-01 through PBT-90-08, PBB-91-01 through PBB-91-07, and the deeper samples from PBS-91-109 through PBS-91-118.



**TABLE 6-22**  
**SUMMARY OF RISK ESTIMATES -**  
**PROPELLANT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Current and Future Grounds Maintenance Worker	Soil Ingestion	$2 \times 10^{-6}$	0.005
	Inhalation of particulates and vapors	$2 \times 10^{-8}$	<u>0.0000002</u>
	Total for Grounds Maintenance Worker	$2 \times 10^{-6}$	0.005
Future Residential	Soil Ingestion	$8 \times 10^{-5}$	0.8
Future Farmer	Soil Ingestion	$1 \times 10^{-5}$	0.02
	Inhalation of Particulates and Volatiles	$7 \times 10^{-5}$	<u>0.03</u>
	Total for Farmer	$8 \times 10^{-5}$	0.05
Future Construction Worker	Soil Ingestion	$2 \times 10^{-6}$	0.8
	Inhalation of Particulates and Volatiles	$1 \times 10^{-7}$	<u>0.00007</u>
	Total for Construction Worker	$2 \times 10^{-6}$	0.8



TABLE 6-23  
COMPOUNDS OF POTENTIAL CONCERN -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF CONCERN	EXPOSURE POINT CONCENTRATION* - (ug/g)													
	FINAL CREEK OUTFLOW		FINAL CREEK		SETTLING POND 1		SETTLING POND 2		SETTLING POND 3		SETTLING POND 4	SPILLS DISPOSAL AREA 1	SPILLS DISPOSAL AREA 2	SPILLS DISPOSAL AREA 3
	SUR. <sup>1</sup>	SUR. <sup>2</sup>	SUR. <sup>3</sup>	SUR. <sup>4</sup>	SUR. <sup>5</sup>	SUR. <sup>6</sup>	SUR. <sup>7</sup>	SUR. <sup>8</sup>	SUR. <sup>9</sup>	SUR. <sup>10</sup>	SUR. <sup>11</sup>	SUR. <sup>12</sup>	SUR. <sup>13</sup>	SUR. <sup>14</sup>
24DNT	--	--	6	172	17.1	7.6	0.04	2.6	0.057	--	12	1.3	1.1	0.7
26DNT	--	--	40	26	--	--	--	1.5	--	--	1	--	--	--
2NNOPA	--	--	2	0.97	--	--	--	--	--	--	--	--	--	--
AL	--	--	--	--	--	--	--	--	--	60,000	--	--	--	--
ANAPYL	0.166	--	--	--	--	--	--	--	--	--	--	--	--	--
B2EHP	1.02	--	--	--	--	--	--	--	--	--	0.35	--	--	0.32
BAANTR	0.185	--	--	--	--	--	--	--	--	--	--	--	--	--
BBFANT	0.723	--	--	--	--	--	--	--	--	--	--	--	--	--
BGHIPI	0.618	--	--	--	--	--	--	--	--	--	--	--	--	--
BKFANT	0.635	--	--	--	--	--	--	--	--	--	--	--	--	--
BR	--	--	--	--	--	--	--	--	--	--	12	4	--	16
CH2CL2	--	--	--	--	--	--	--	--	--	--	0.034	0.024	0.025	0.038
CHRY	0.264	--	--	--	--	--	--	--	--	--	--	--	--	--
CL	--	--	--	--	--	--	--	--	--	--	19	23	17	13
DEP	--	--	0.13	460	1,340	135	--	44	--	--	--	--	--	--
DNOP	--	--	26	14	--	0.74	--	17.4	--	--	51	5.8	4	4.4
														6.5



continued

TABLE 6-23  
COMPOUNDS OF POTENTIAL CONCERN -  
SETTLING PONDS AND SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

EXPOSURE POINT CONCENTRATION * - (ug/g)																						
COMPOUND OF CONCERN	FINAL CREEK OUTFLOW		FINAL CREEK	SETTLING POND 1		SETTLING POND 2		SETTLING POND 3		SETTLING POND 4	SPOLS DISPOSAL AREA 1	SPOLS DISPOSAL AREA 2	SPOLS DISPOSAL AREA 3	SPOLS DISPOSAL AREA 4	SPOLS DISPOSAL AREA 5							
	SUR. 1	SUR. 2	SUR. 3	SUR. 4	SUR. 5	SUR. 6	SUR. 7	SUR. 8	SUR. 9	SUR. 10	SUR. 11	SUR. 12	SUR. 13	SUR. 14	SUR. 15							
DNDP	--	--	--	--	--	--	--	--	--	--	8.6	--	--	0.63	0.2							
DPA	--	--	15	10	--	1.5	--	2.8	--	--	24	3.2	2.2	1.1	2.4							
FANT	0.407	--	--	--	--	--	--	--	--	--	--	--	--	--	--							
HG	0.505	--	--	--	--	--	--	--	--	--	--	--	--	--	--							
NC	--	--	740	60,000	--	280	--	190	0.17	1,038	11,000	8,000	3,800	3,000	11,000							
NG	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--							
NH3	--	--	1,800	740	--	840	--	520	--	960	--	--	--	--	--							
NIT	3.53	3.76	11	13	--	43	--	4.9	--	10	16	10	22	12	18							
PB	--	--	40	180	--	250	--	--	--	300	349	373	67	120	102							
PHANTR	0.173	--	--	--	--	--	--	--	--	--	--	--	--	--	--							
PYR	0.487	--	--	--	--	--	--	--	--	--	--	--	--	--	--							
SN	--	--	63	57	--	53	4.7	72	3.9	77	3.68	4.04	5.8	1.64	1.94							
SO4	18.2	35.8	260	2,500	--	64	20.2	36	15.2	400	146	130	75	139	38							



continued

TABLE 6-23  
COMPOUNDS OF POTENTIAL CONCERN -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF CONCERN		EXPOSURE POINT CONCENTRATION <sup>a</sup> - (µg/g)														
		FINAL CREEK OUTFLOW		FINAL CREEK	SETTLING POND 1		SETTLING POND 2		SETTLING POND 3		SETTLING POND 4	SPOILS DISPOSAL AREA 1	SPOILS DISPOSAL AREA 2	SPOILS DISPOSAL AREA 3	SPOILS DISPOSAL AREA 4	SPOILS DISPOSAL AREA 5
					SUR. <sup>4</sup>	SUR. <sup>5</sup>	SUR. <sup>6</sup>	SUR. <sup>7</sup>	SUR. <sup>8</sup>	SUR. <sup>9</sup>						
ZN		SUR. <sup>1</sup>	SUR. <sup>2</sup>	SUR. <sup>3</sup>	SUR. <sup>4</sup>	SUR. <sup>5</sup>	SUR. <sup>6</sup>	SUR. <sup>7</sup>	SUR. <sup>8</sup>	SUR. <sup>9</sup>	SUR. <sup>10</sup>	SUR. <sup>11</sup>	SUR. <sup>12</sup>	SUR. <sup>13</sup>	SUR. <sup>14</sup>	SUR. <sup>15</sup>
		-	-	-	-	-	-	-	-	-	-	212	748	251	204	306

Notes:

<sup>1</sup> Exposure point concentration is the maximum concentration detected  
Subsurface data available only for Final Creek Outflow, Settling Pond 1, Settling Pond 2, and  
Settling Pond 3.

<sup>2</sup> = not identified as compound of potential concern

µg/g = micrograms per gram; equivalent to parts per million (ppm)

Sur. = Surface

Sub. = Subsurface

<sup>1</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from  
boring SPB-91-01.

<sup>2</sup> Assessment of subsurface soil contamination (2 to 12 feet) was performed using data from  
boring SPB-91-01.

<sup>3</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from  
samples FC-1 through FC-8.

<sup>4</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from  
samples FPI-1 through FPI-14, and S1201 through S1204.

<sup>5</sup> Assessment of subsurface soil contamination (2 to 16 feet) was performed using data from  
samples S1201 through S1204.

<sup>6</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from  
samples FPI-1 through FPI-3 and S1205.

<sup>7</sup> Assessment of subsurface soil contamination (2 to 16 feet) was performed using data from  
sample S1205.

<sup>8</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from  
samples FPI-1 through FPI-15 and S1206.

<sup>9</sup> Assessment of subsurface soil contamination (2 to 16 feet) was performed using data from  
boring S1206.

<sup>10</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples FPIV-1  
through FPIV-10 and S1207.

<sup>11</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples SD1-1  
through SD1-5.

<sup>12</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples SD2-1  
through SD2-5.

<sup>13</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from  
SD3-1 through SD3-10.

<sup>14</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from  
SD4-1 through SD4-10.

<sup>15</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from  
SD5-1 through SD5-10.



**TABLE 6-24**  
**SUMMARY OF RISK ESTIMATES -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
<b>Final Creek Outflow</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$4 \times 10^{-7}$	0.0002
	Inhalation of Particulates and Vapors	<u><math>2 \times 10^{-11}</math></u>	<u>0.0000004</u>
	Total Grounds Maintenance Worker	$4 \times 10^{-7}$	0.0002
Future Residential	Soil Ingestion	$2 \times 10^{-5}$	0.03
Future Construction Worker	Soil Ingestion	$7 \times 10^{-8}$	0.01
	Inhalation of Particulates and Volatiles	<u><math>4 \times 10^{-10}</math></u>	<u>0.0009</u>
	Total Construction Worker	$7 \times 10^{-8}$	0.06
<b>Final Creek</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$1 \times 10^{-6}$	0.0004
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$1 \times 10^{-6}$	0.0004
Future Residential	Soil Ingestion	$5 \times 10^{-5}$	0.06
<b>Settling Pond 1</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$5 \times 10^{-6}$	0.008
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$5 \times 10^{-6}$	0.008
Future Residential	Soil Ingestion	$2 \times 10^{-4}$	1.0
Future Construction Worker	Soil Ingestion	$7 \times 10^{-7}$	0.006
	Inhalation of Particulates and Volatiles	<u>ND</u>	<u>ND</u>
	Total Construction Worker	$7 \times 10^{-7}$	0.006



continued

**TABLE 6-24**  
**SUMMARY OF RISK ESTIMATES -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
<b>Settling Pond 2</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$2 \times 10^{-7}$	0.0004
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$2 \times 10^{-7}$	0.0004
Future Residential	Soil Ingestion	$8 \times 10^{-6}$	0.06
Future Construction Worker	Soil Ingestion	$3 \times 10^{-8}$	0.004
	Inhalation of Particulates and Volatiles	<u>ND</u>	<u>ND</u>
	Total Construction Worker	$3 \times 10^{-8}$	0.004
<b>Settling Pond 3</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$9 \times 10^{-8}$	0.0002
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$9 \times 10^{-8}$	0.0002
Future Residential	Soil Ingestion	$4 \times 10^{-6}$	0.03
Future Construction Worker	Soil Ingestion	$1 \times 10^{-8}$	0.002
	Inhalation of Particulates and Volatiles	<u>ND</u>	<u>ND</u>
	Total Construction Worker	$1 \times 10^{-8}$	0.002
<b>Settling Pond 4</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	ND	0.00002
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	ND	0.00002
Future Residential	Soil Ingestion	ND	0.003



continued

**TABLE 6-24**  
**SUMMARY OF RISK ESTIMATES -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>EXPOSURE SCENARIO</b>	<b>EXPOSURE ROUTE</b>	<b>CANCER RISK</b>	<b>HAZARD INDEX</b>
<b>Spoils Disposal Area 1</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$3 \times 10^{-7}$	0.0009
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$3 \times 10^{-7}$	0.0009
Future Residential	Soil Ingestion	$1 \times 10^{-5}$	0.1
<b>Spoils Disposal Area 2</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$3 \times 10^{-8}$	0.0004
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$3 \times 10^{-8}$	0.0004
Future Residential	Soil Ingestion	$1 \times 10^{-6}$	0.06
<b>Spoils Disposal Area 3</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$3 \times 10^{-8}$	0.0002
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$3 \times 10^{-8}$	0.0002
Future Residential	Soil Ingestion	$1 \times 10^{-6}$	0.03
<b>Spoils Disposal Area 4</b>			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$2 \times 10^{-8}$	0.0002
	Inhalation of Particulates and Vapors	<u>ND</u>	<u>ND</u>
	Total Grounds Maintenance Worker	$2 \times 10^{-8}$	0.0002
Future Residential	Soil Ingestion	$8 \times 10^{-7}$	0.02



continued

TABLE 6-24  
SUMMARY OF RISK ESTIMATES -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Spoils Disposal Area 5			
Current and Future Grounds Maintenance Worker	Soil Ingestion	$7 \times 10^{-12}$	0.0002
	Inhalation of Particulates and Vapors	ND	ND
	Total Grounds Maintenance Worker	$7 \times 10^{-12}$	0.0002
Future Residential	Soil Ingestion	$3 \times 10^{-10}$	0.03

Notes:

ND = Not determined - no toxicity values available for compounds of potential concern.



TABLE 6-25  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g/l}$   
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)			WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	ES	PAL	
111TCE	14:94	59.3	2.52	200	200	200	200	40	-
26DNT	6:188	1.46	0.839	-	-	0.05	0.05	0.005	-
BA	70:70	130	24.1	2,000	2,000	1,000(c)	1,000(c)	200(c)	-
BE	11:70	0.582	0.348	-	-	-	-	-	0.02
CCL4	123:197	108	1.86	5	0	5	5	0.5	-
CD	3:120	3.61	2.8	5	5	10(d)	10(d)	1(d)	-
CHCL3	132:197	83.5	0.483	-	-	6	6	0.6	-
CL	187:187	140,000	2,400	250,000(a)	-	-	-	-	-
CR	57:120	46.6	4.93	100	100	50(e)	50(e)	5(e)	-
CU	29:70	23.1	4.58	TT	1,300	-	-	-	-
HG	2:120	4.31	2.83	2	2	2	2	0.2	-
MN	9:70	1,700	11.2	50(a)	-	50(f)	50(f)	25(f)	-
NA	48:70	94,000	2,090	20,000(b)	-	-	-	-	-
NIT	178:185	21,000	140	10,000	10,000	10,000	10,000	2,000	-
NNDPA	16:186	25	0.955	-	-	-	-	-	20
PB	18:120	13.6	5.54	TT	0	50(g)	50(g)	5(g)	-
SO4	179:179	637,000	1.5	250,000(a)	-	250,000(f)	250,000(f)	125,000(f)	-
TRCLE	124:197	117	0.329	5	0	5	5	0.18	-



continued

TABLE 6-25  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g/l}$   
PROPELLANT BURNING GROUND/LANDFILL 1/SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)	CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL
V	10:70	19.1	5.01	-	-	-	260
ZN	11:70	1,900	29	-	-	5,000(f)	7,300

Sources:

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards," Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of  $10^{-6}$  or HI of 1 (see Subsection 4.5 for details).

Notes:

- (a) Secondary drinking water standard, suggested level.
  - (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
  - (c) WI proposing change to ES = 2,000  $\mu\text{g/l}$  and PAL = 400  $\mu\text{g/l}$
  - (d) WI proposing change to ES = 5  $\mu\text{g/l}$  and PAL = 0.5  $\mu\text{g/l}$
  - (e) WI proposing change to ES = 100  $\mu\text{g/l}$  and PAL = 10  $\mu\text{g/l}$
  - (f) Values are for protection of public welfare (usually aesthetic concerns) rather than for protection of public health
  - (g) WI proposing change to ES = 15  $\mu\text{g/l}$  and PAL = 1.5  $\mu\text{g/l}$
- $\mu\text{g/l}$  = micrograms per liter
- SDWA = Safe Drinking Water Act
- MCL = Maximum Contaminant Level
- MCLG = Maximum Contaminant Level Goal
- WI = Wisconsin
- ES = Enforcement Standard
- PAL = Preventive Action Limit
- TT = Treatment technique requirement in effect
- Copper action level - 1,300  $\mu\text{g/l}$
- Lead action level - 15  $\mu\text{g/l}$



**TABLE 6-26**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**PROPELLANT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
24DNT	16:114	10.7
2MNAP	2:13	0.452
AS	83:108	9.45
B2EHP	1:13	6.2
BAANTR	1:13	0.204
C6H6	8:114	0.42
CHRY	1:13	3.68
CR	108:108	49.8
CU	108:108	344
DEP	7:13	6.2
DNBP	4:13	6.35
FANT	2:13	0.2
HG	31:108	0.334
NI	108:108	27.3
NNDPA	3:13	30.8
PB	108:108	2,700
PHANTR	3:13	1.32
PYR	1:13	0.168
SE	10:108	0.618
ZN	108:108	1,040

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-5 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$

<sup>C</sup> Assessment of surface soil contamination was performed using samples PBS-91-01 through PBS-91-108. In addition, the upper portions of samples PBS-91-109 through PBS-91-114 were used to assess contamination of surface soil by 24DNT, 26DNT, C6H6, and CCL3F.



**TABLE 6-27**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**FINAL CREEK AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	8:8	40
SN	7:8	63
NIT	8:8	11
NH3	8:8	1,800
SO4	4:8	260
24DNT	5:8	6
26DNT	6:8	40
DEP	2:8	0.13
DNBP	5:8	26
DPA	6:8	15
2NNDPA	3:8	2
NC	3:8	740

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-6 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from samples FC-1 through FC-8.



**TABLE 6-28**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SETTLING POND 1**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	16:17	180
SN	17:17	57
NIT	14:16	13
NH3	14:14	740
SO4	8:18	2,500
24DNT	5:15	172
26DNT	6:14	26
DEP	1:15	460
BP	6:15	14
DPA	6:14	10
2NNDPA	3:14	0.97
NC	7:15	60,000

**Notes:**

- <sup>A</sup> Constituents selected based on criteria presented in Table Q-7 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from samples FPI-1 through FPI-14, and S1201 through S1204.



**TABLE 6-29**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>a</sup> -**  
**SETTLING POND 2**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>b</sup>
<u>Surface Soil<sup>c</sup></u>		
PB	3:3	250
SN	3:3	53
NIT	3:3	43
NH3	3:3	840
SO4	1:3	64
24DNT	1:4	7.6
26DNT	1:4	135
DEP	1:4	0.74
DNBP	1:3	1.5
DPA	1:3	1.5
NC	2:3	280

**Notes:**

- <sup>a</sup> Constituents selected based on criteria presented in Table Q-8 and discussed in Section 5.0.
- <sup>b</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>c</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from samples FPII-1 through FPII-3 and S1205.



**TABLE 6-30**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SETTLING POND 3**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	15:15	34
SN	15:15	72
NIT	15:15	4.9
NH3	15:15	520
SO4	2:15	36
24DNT	1:16	2.6
26DNT	1:15	1.5
DEP	1:16	44
DNBP	5:16	17.4
DPA	4:15	2.8
NC	2:15	190

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-9 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using data from samples FPIII-1 through FPIII-15 and S1206.



**TABLE 6-31**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SETTLING POND 4**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
AL	11:11	60,000
PB	11:11	300
SN	11:11	77
NIT	10:11	10
NH3	10:10	960
SO4	3:11	400
DPA	1:10	0.36
NC	2:11	1,038

**Notes:**

- <sup>A</sup> Constituents selected based on criteria presented in Table Q-10 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples FPIV-1 through FPIV-10 and S1207.



**TABLE 6-32**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SPOILS DISPOSAL AREA 1**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	5:5	249
SN	5:5	3.68
ZN	5:5	212
BR	2:2	12
CL	5:5	19
NIT	5:5	16
SO4	5:5	146
CH2CL2	3:3	0.01
24DNT	3:3	12
26DNT	1:1	1
B2EHP	1:1	0.35
DNBP	5:5	51
DNOP	1:1	8.6
DPA	4:4	24
NC	5:5	11,000
NG	1:1	19

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-11 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in µg/g.

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples SD1-1 through SD1-5.



**TABLE 6-33**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SPOILS DISPOSAL AREA 2**

**REMEDIATION INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	5:5	373
SN	5:5	4.04
ZN	5:5	748
BR	1:1	4
CL	5:5	23
NIT	5:5	10
SO4	5:5	130
CH2CL2	3:3	.012
24DNT	4:4	1.3
DNBP	5:5	5.8
DPA	5:5	3.2
NC	5:5	8.000

**Notes:**

- <sup>A</sup> Constituents selected based on criteria presented in Table Q-12 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples SD2-1 through SD2-5.



**TABLE 6-34**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SPOILS DISPOSAL AREA 3**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	10:10	67
SN	10:10	5.8
ZN	10:10	251
CL	10:10	17
NIT	10:10	22
SO4	10:10	75
CH2CL2	1:1	0.025
24DNT	5:5	1.1
DNBP	9:9	4
DPA	5:5	2.2
NC	10:10	3,800

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-13 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from SD3-1 through SD3-10.



**TABLE 6-35**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SPOILS DISPOSAL AREA 4**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	10:10	120
SN	10:10	1.64
ZN	10:10	204
CL	9:9	13
NIT	10:10	12
SO4	10:10	139
CH2CL2	4:4	0.01
24DNT	1:1	0.7
B2EHP	1:1	0.32
DNBP	4:4	4.4
DNOP	3:3	0.63
DPA	1:1	1.1
NC	9:9	3,000

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-14 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from SD4-1 through SD4-10.



**TABLE 6-36**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**SPOILS DISPOSAL AREA 5**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
PB	8:8	102
SN	10:10	1.94
ZN	9:9	306
BR	1:1	16
CL	9:9	18
NIT	10:10	18
SO4	10:10	38
CH2CL2	3:3	0.01
DNBP	7:7	6.5
DNOP	1:1	0.2
DPA	3:3	2.4
NC	8:8	11,000

**Notes:**

<sup>A</sup> Constituents selected based on criteria presented in Table Q-15 and discussed in Section 5.0.

<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .

<sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from SD5-1 through SD5-10.



**TABLE 6-37**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS -**  
**PROPELLANT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>A</sup>	
	ACUTE RISK <sup>B</sup>	CHRONIC RISK <sup>C</sup>
Short-tailed shrew	5.5E+03	1.1E+05
Eastern meadowlark	2.8E+02	2.0E+03
Garter snake	3.8E+02	6.3E+03
Red fox	2.2E+01	3.7E+01
Red-tailed hawk	2.5E+02	2.4E+02

**Notes:**

<sup>A</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dosage by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-31 and R-32 for acute and chronic exposures, respectively.

<sup>B</sup> Based on comparison to acute RTVs.

<sup>C</sup> Based on comparison to chronic RTVs.



TABLE 6-38  
SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS -  
SETTLING PONDS AND SPOILS DISPOSAL AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

RECEPTOR	HAZARD INDICES <sup>A</sup>	
	ACUTE RISK <sup>B</sup>	CHRONIC RISK <sup>C</sup>
<u>Final Creek Area</u>		
Short-tailed shrew	8.0E+01	2.6E+03
Eastern meadowlark	2.0E+00	2.8E+00
Garter snake	3.9E+00	5.1E+01
Red fox	5.1E-1	2.2E-1
Red-tailed hawk	5.5E-01	2.4E-02
<u>Settling Pond 1 Area</u>		
Short-tailed shrew	3.5E+02	7.8E+03
Eastern meadowlark	8.3E+00	2.4E+01
Garter snake	1.7E+01	3.9E+02
Red fox	2.3E+00	3.8E+00
Red-tailed hawk	2.0E+00	7.5E-01
<u>Settling Pond 2 Area</u>		
Short-tailed shrew	4.7E+02	1.0E+04
Eastern meadowlark	1.1E+01	3.2E+01
Garter snake	2.4E+01	5.1E+01
Red fox	6.6E-01	8.5E-01
Red-tailed hawk	1.9E+00	2.6E-01
<u>Settling Pond 3 Area</u>		
Short-tailed shrew	6.8E+01	2.5E+03
Eastern meadowlark	1.7E+00	6.4E+00
Garter snake	3.4E+00	1.3E+02
Red fox	2.0E-01	3.5E+00
Red-tailed hawk	5.5E-01	2.7E-01
<u>Settling Pond 4 Area</u>		
Short-tailed shrew	6.7E+02	1.4E+04
Eastern meadowlark	2.0E+01	1.0E+02
Garter snake	3.3E+01	6.8E+02
Red fox	3.5E+00	5.6E+00
Red-tailed hawk	1.1E+01	4.6E+00
<u>Spoils Disposal Site 1 Area</u>		
Short-tailed shrew	6.6E+02	1.3E+04
Eastern meadowlark	1.5E+01	4.3E+01
Garter snake	3.3E+01	6.6E+02
Red fox	1.7E+00	2.5E-01
Red-tailed hawk	5.5E+00	3.3E-01
<u>Spoils Disposal 2 Area</u>		
Short-tailed shrew	7.2E+02	1.4E+04
Eastern meadowlark	1.7E+01	3.4E+01
Garter snake	3.6E+01	4.9E+02



continued

**TABLE 6-38**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS -**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>A</sup>	
	ACUTE RISK <sup>B</sup>	CHRONIC RISK <sup>C</sup>
Red fox	3.1E+00	2.3E-01
Red-tailed hawk	1.1E+01	3.5E-01
<u>Spoils Disposal 3 Area</u>		
Short-tailed shrew	1.3E+2	2.6E+03
Eastern meadowlark	3.3E+00	5.7E+00
Garter snake	6.7E+00	7.9E+01
Red fox	8.7E-01	7.2E-02
Red-tailed hawk	3.2E+00	7.7E-02
<u>Spoils Disposal 4 Area</u>		
Short-tailed shrew	2.3E+02	4.6E+03
Eastern meadowlark	5.5E+00	1.5E+01
Garter snake	1.2E+01	2.3E+02
Red fox	1.1E+00	1.2E-01
Red-tailed hawk	3.8E+00	1.7E-01
<u>Spoils Disposal 5 Area</u>		
Short-tailed shrew	2.0E+02	3.9E+03
Eastern meadowlark	4.9E+00	1.4E+01
Garter snake	1.0E+01	1.9E+02
Red fox	1.4E+00	1.4E-01
Red-tailed hawk	5.2E+00	2.1E-01

**Notes:**

<sup>A</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dosage by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-33 through R-52.

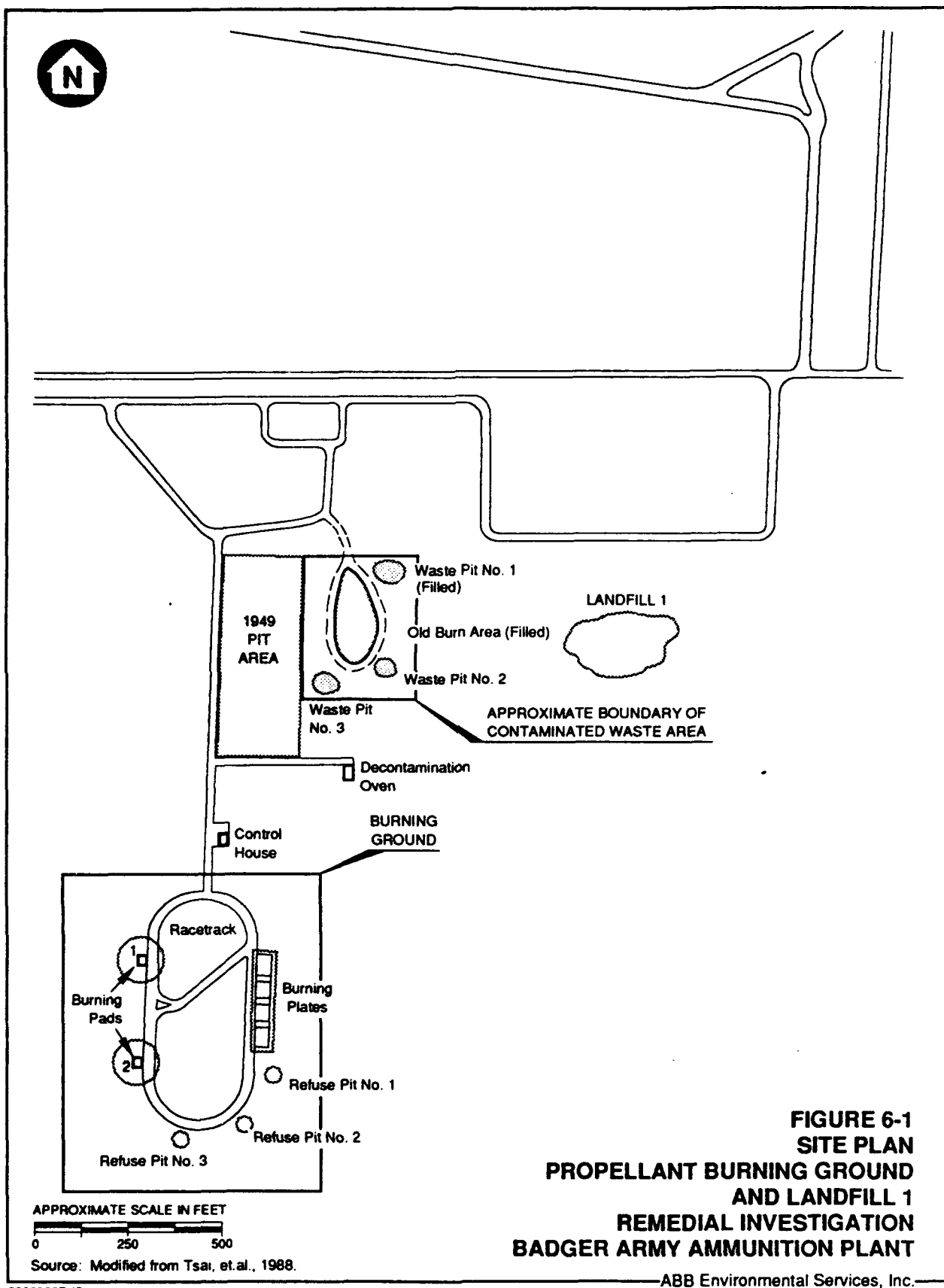
<sup>B</sup> Based on comparison to acute RTVs.

<sup>C</sup> Based on comparison to chronic RTVs.



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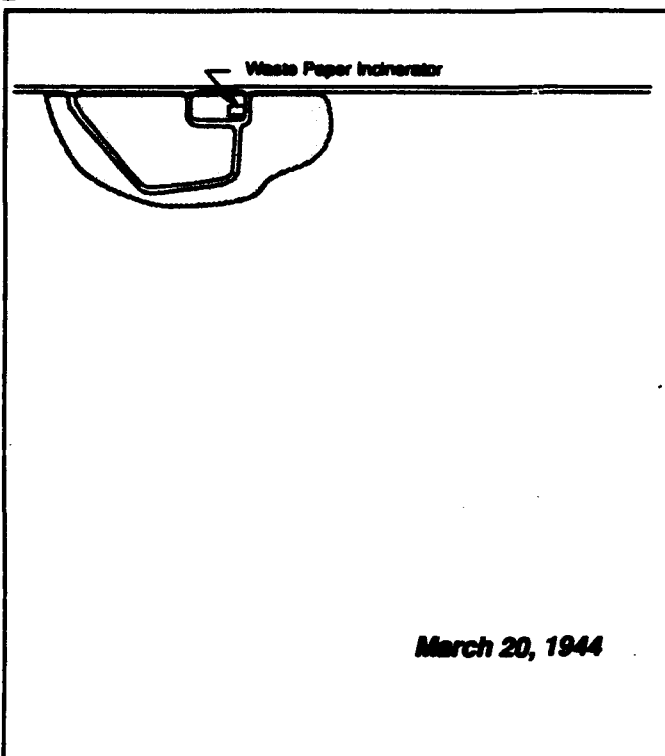
**FIGURE 6-1**  
**SITE PLAN**  
**PROPELLANT BURNING GROUND**  
**AND LANDFILL 1**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

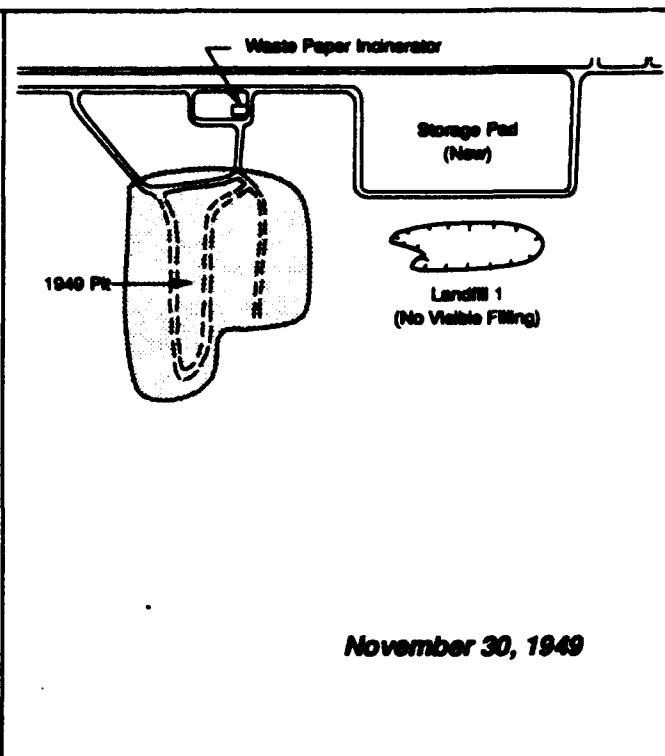




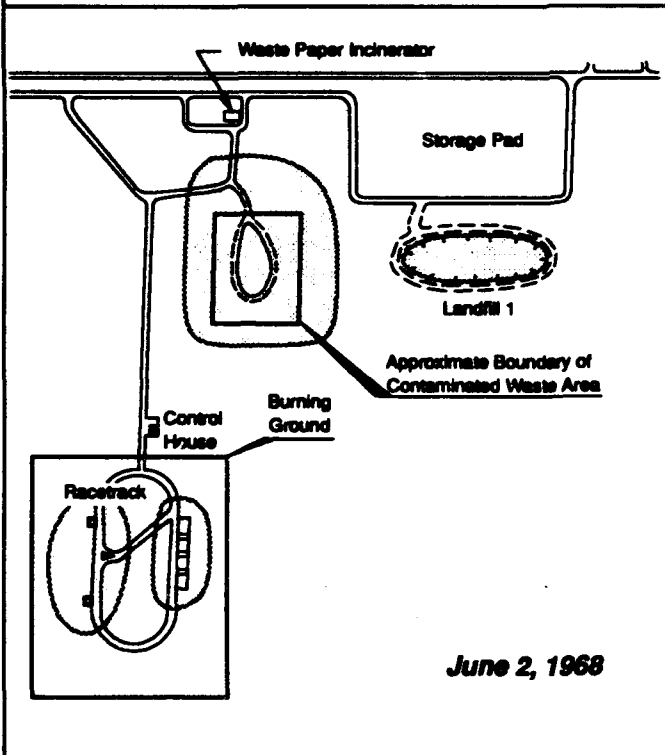
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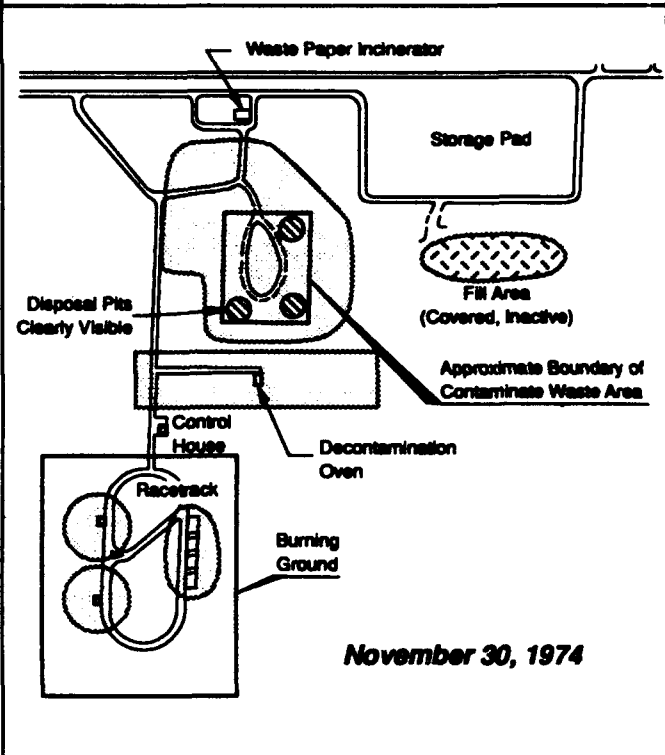
March 20, 1944



November 30, 1949



June 2, 1968



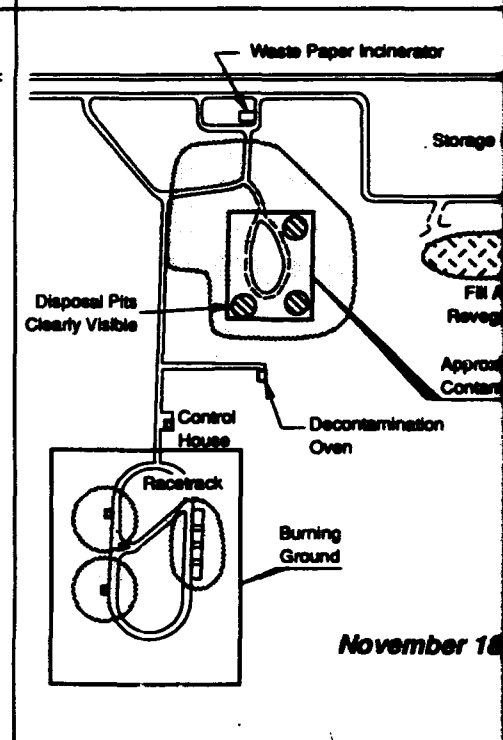
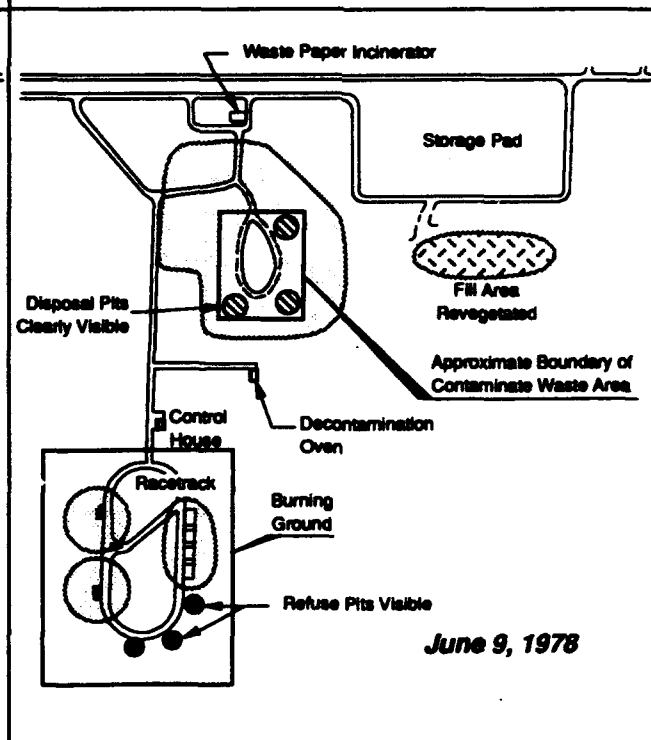
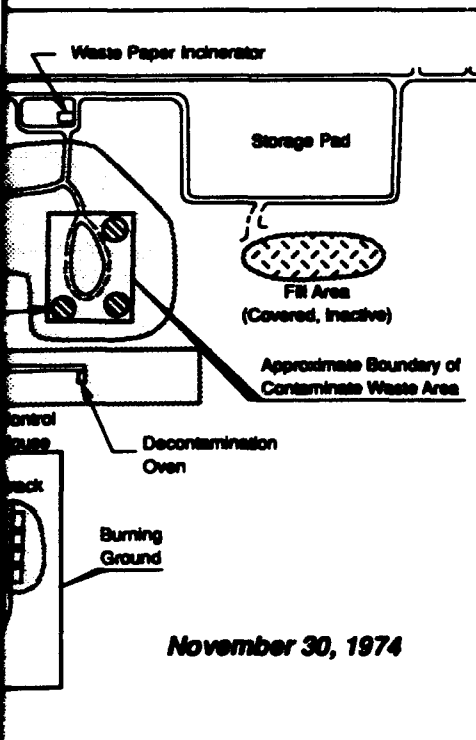
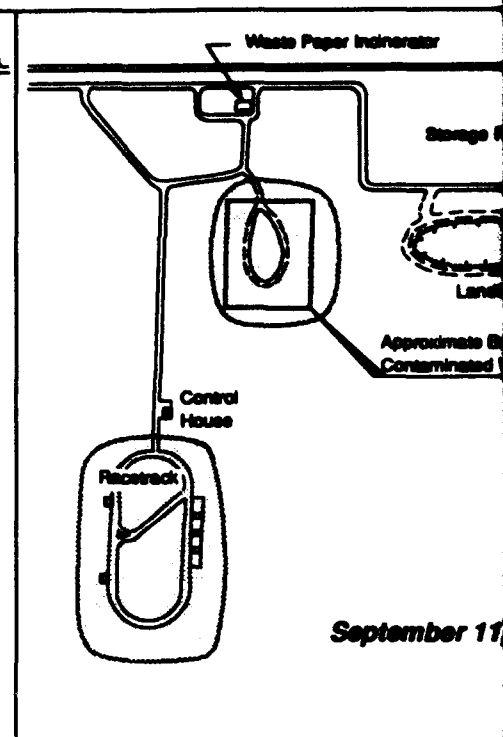
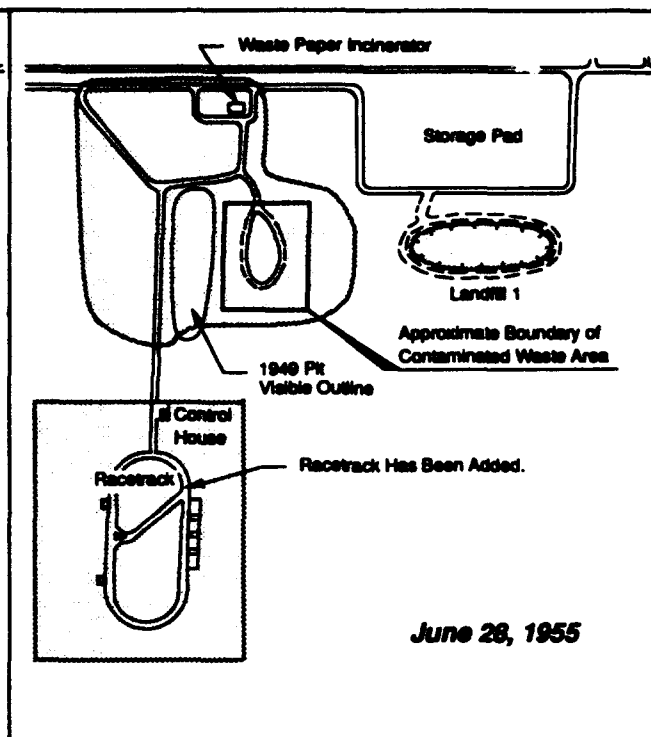
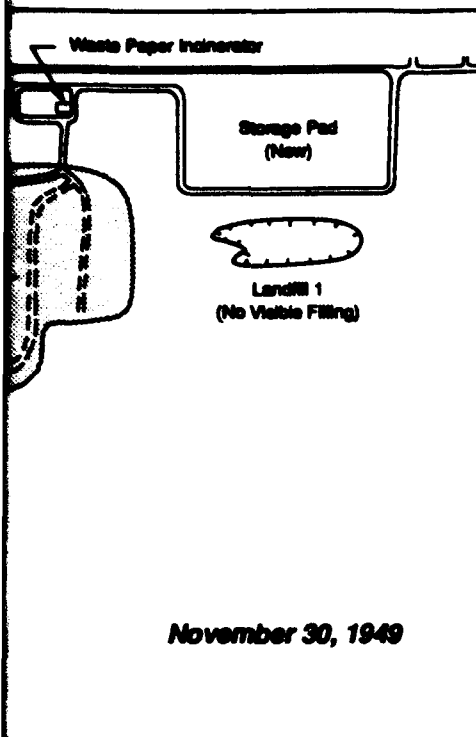
November 30, 1974

**LEGEND**

- TOP EDGE OF SLOPE
- ACTIVE AREA
- ACCESS ROAD

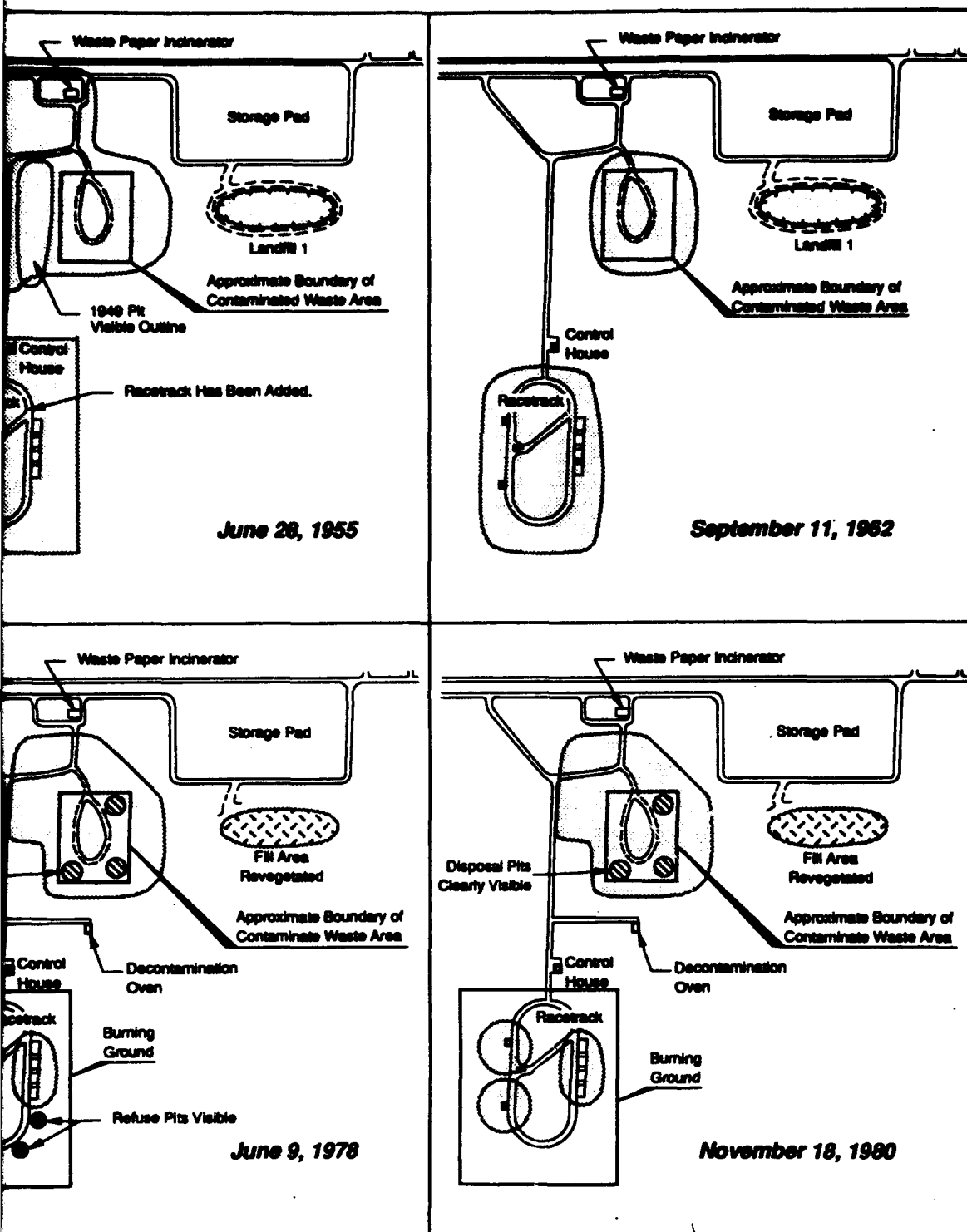


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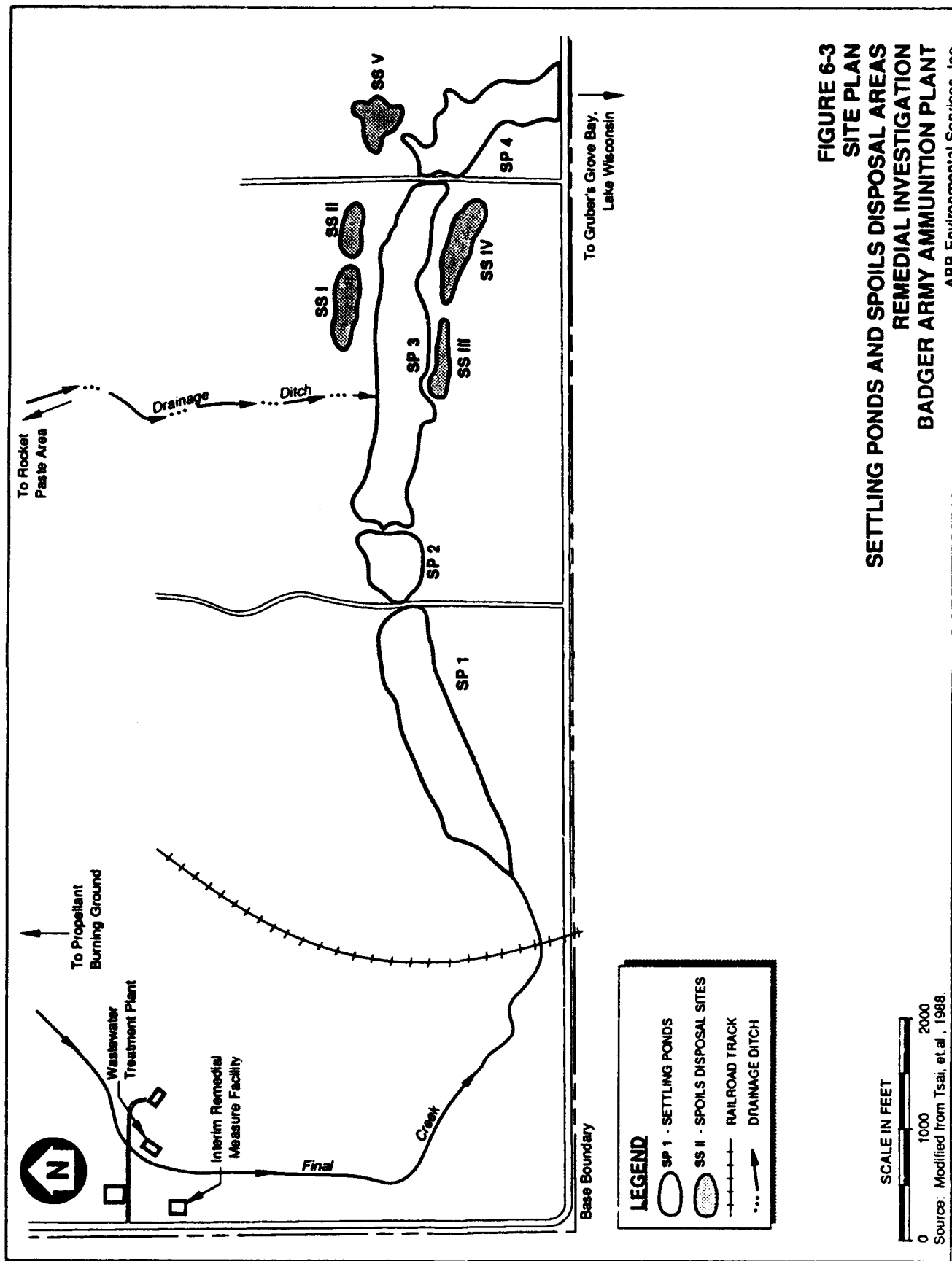
# CHRONOLOGICAL EVOLUTION OF THE PROPELLANT BURNING REMEDIAL INVESTIGATION BADGER ARMY AMMUNITION PLANT ABB Environmental



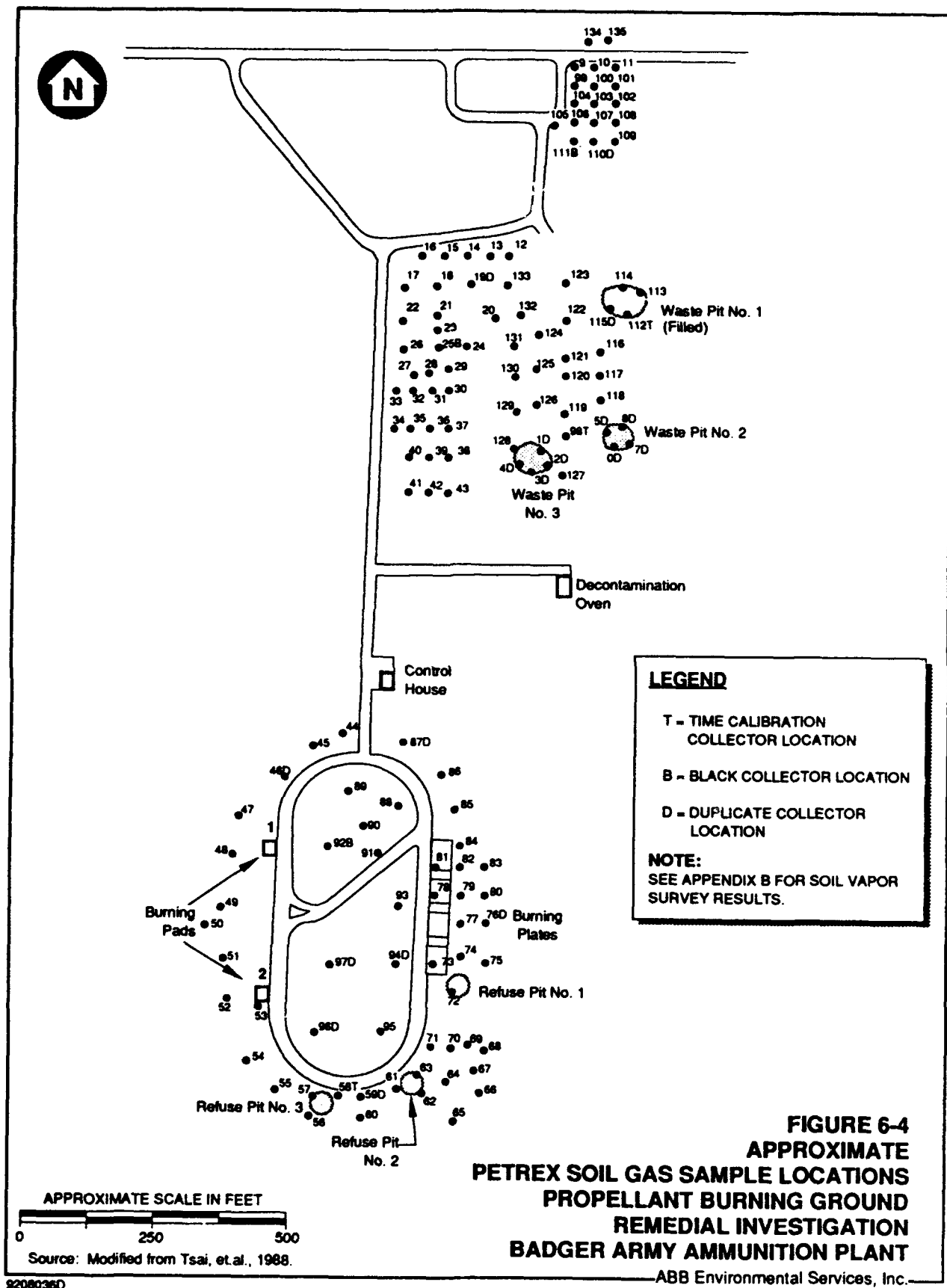


**FIGURE 6-2**  
**CHRONOLOGICAL EVOLUTION OF THE PROPELLANT BURNING GROUND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.

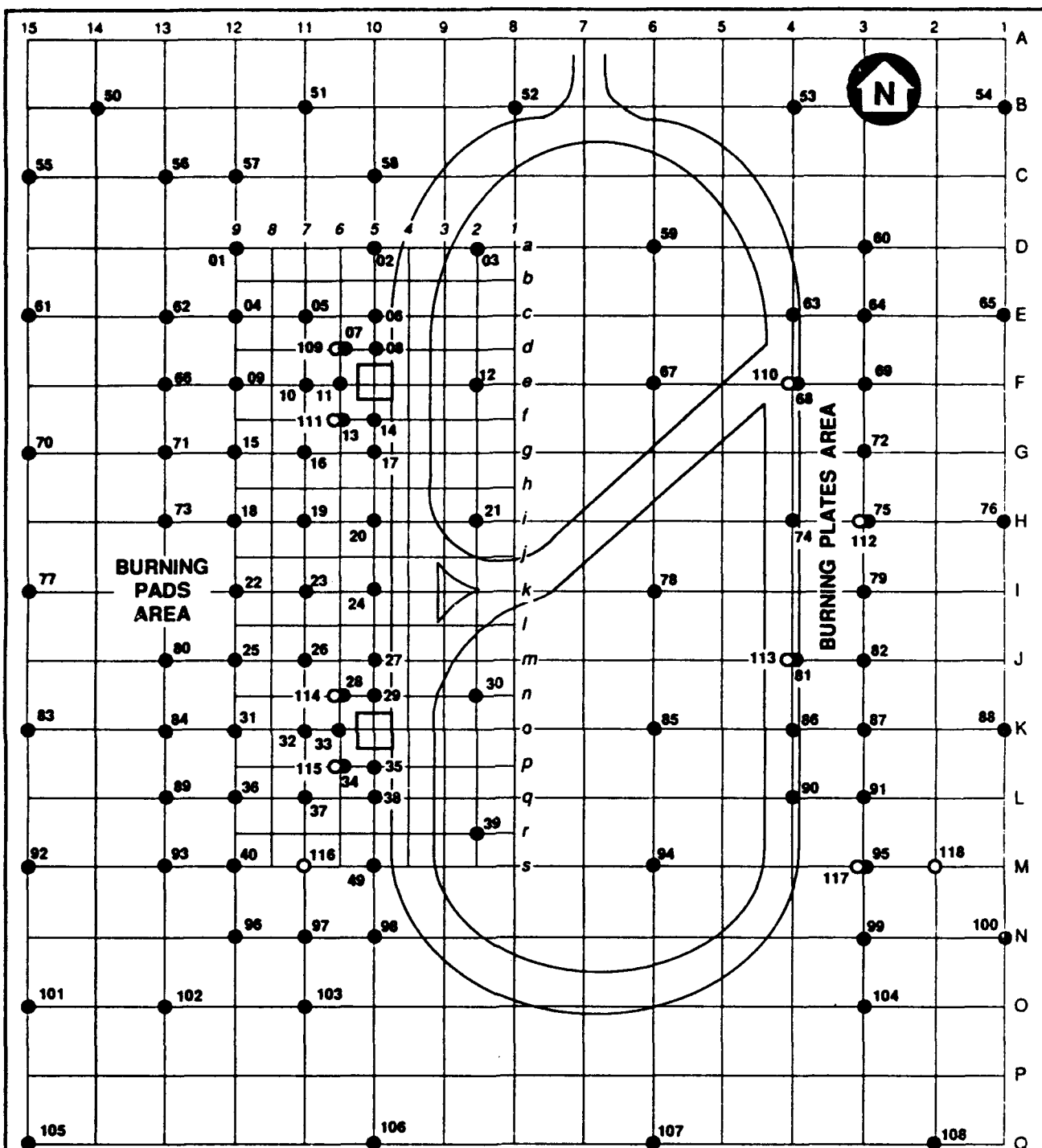












# **LEGEND**

- 01 ● SURFACE SOIL SAMPLE LOCATION (PBS-91-01)
- 109 ○ SUBSURFACE SOIL SAMPLE LOCATION (PBS-91-109)
- APPROXIMATE SIZE OF CONCRETE BURNING PADS

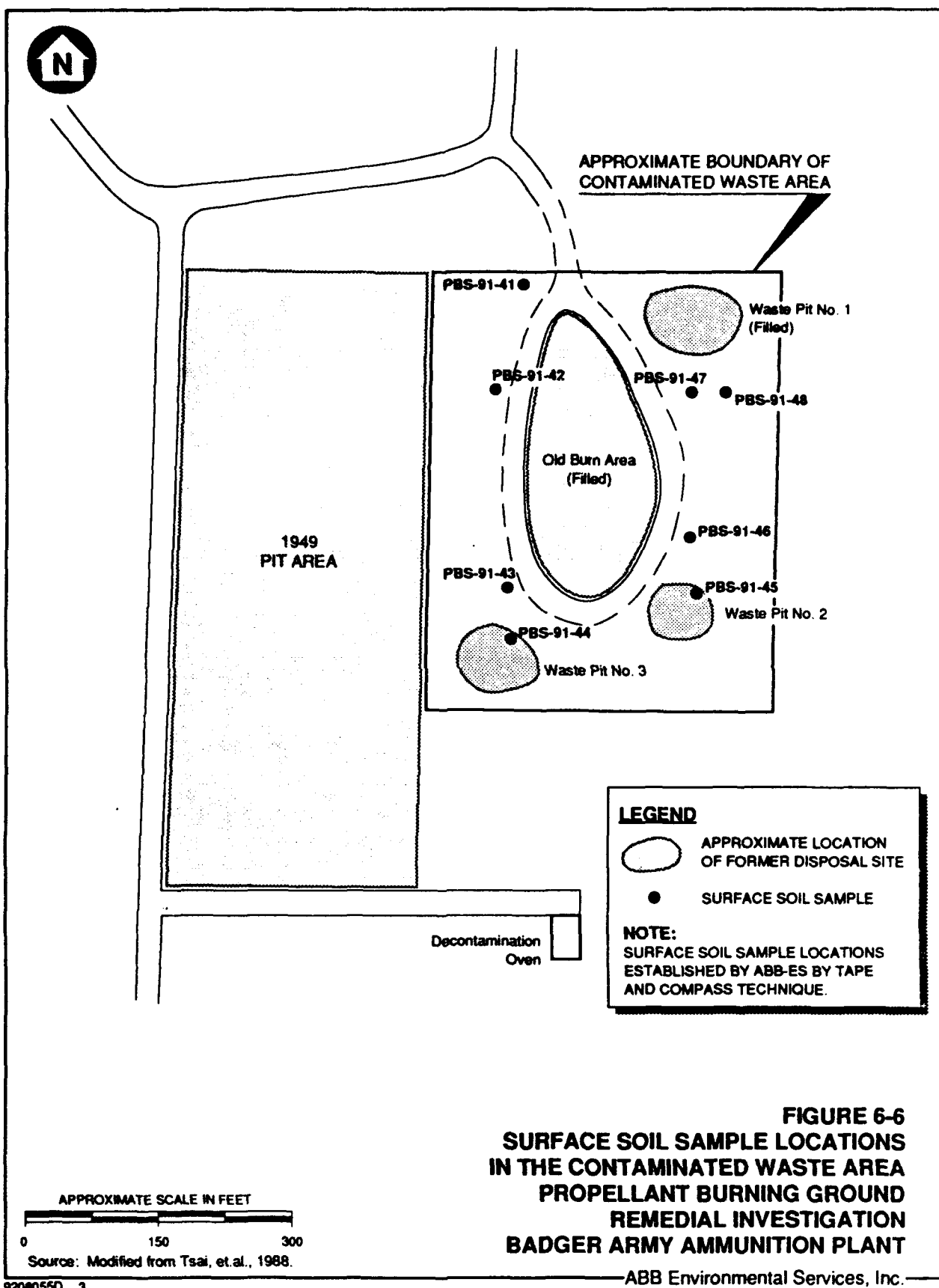
NOTE: SAMPLE LOCATIONS 41 THROUGH 48 ARE LOCATED OFF THE GRID IN THE CONTAMINATED WASTE AREA (FIGURE 6-6).  
 SOURCE: MODIFIED FROM FIGURE 4-12 OF TSAI ET AL., 1988.

SCALE IN FEET  
 0 100 200

**FIGURE 6-5**  
**SURFACE SOIL SAMPLE LOCATIONS**  
**AT THE RACETRACK**  
**PROPELLANT BURNING GROUND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

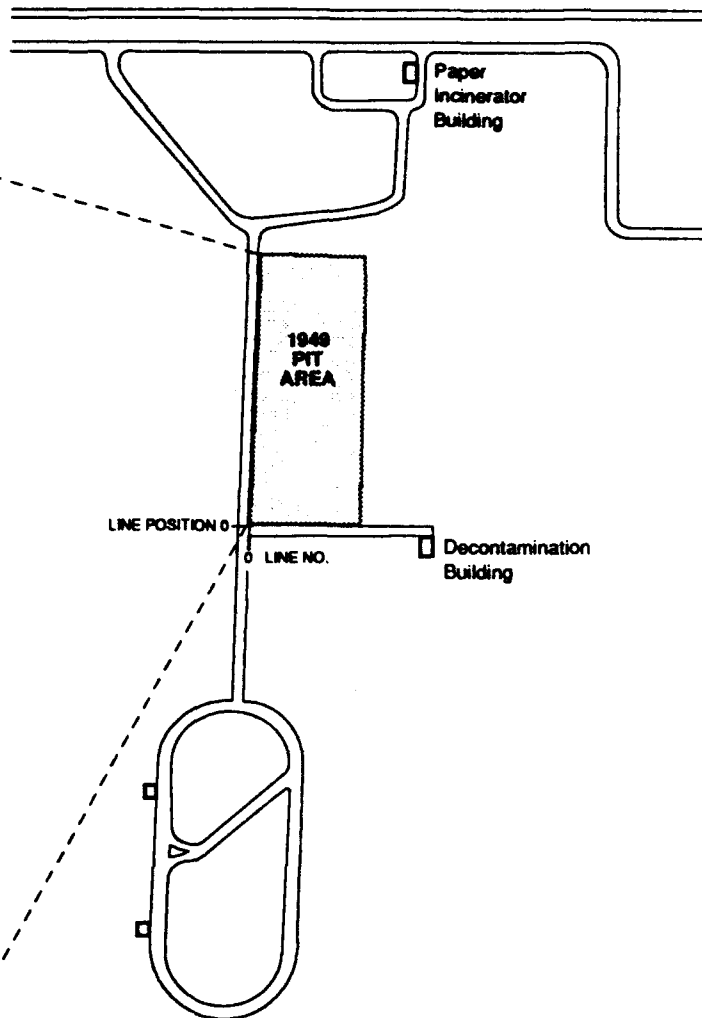
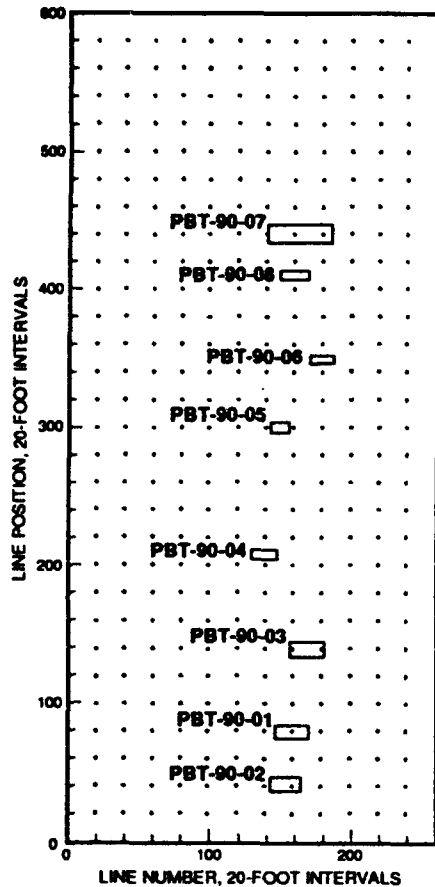








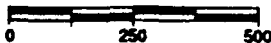
AREA SURVEYED BY GROUND  
PENETRATING RADAR AND  
MAGNETOMETER



**LEGEND**

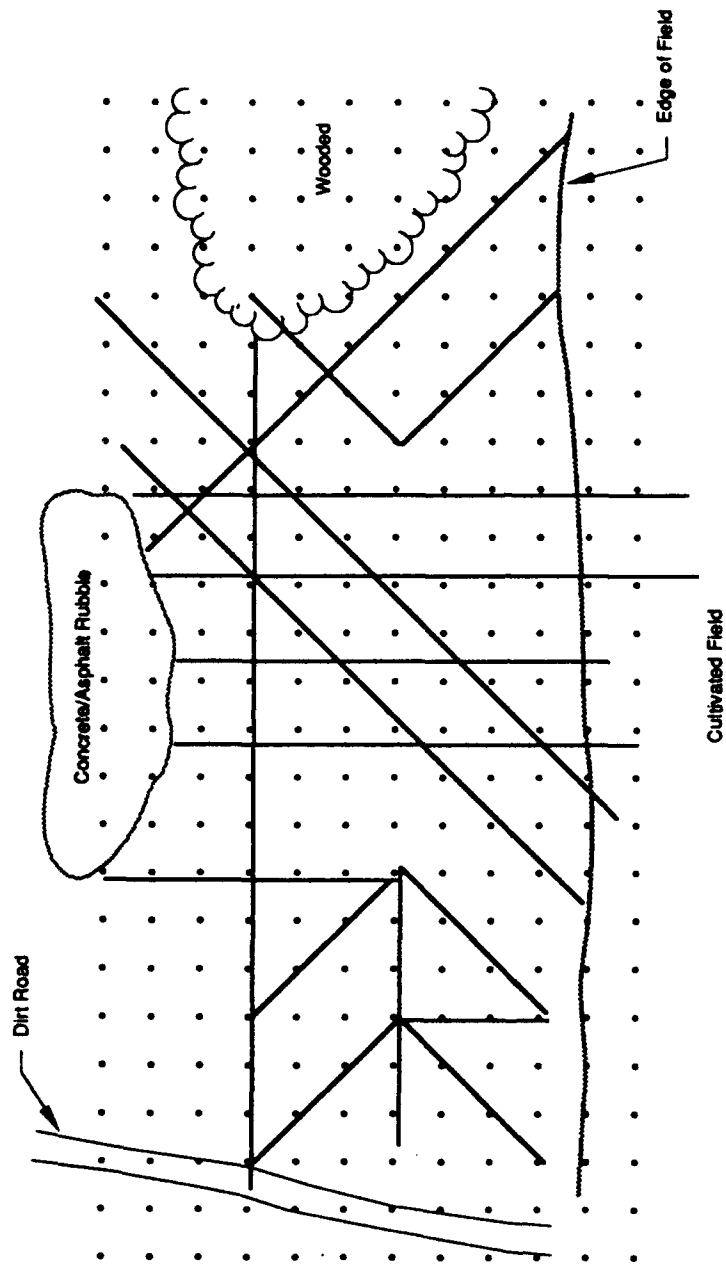
- • • GRID POINTS
- PBT-90-01  TEST PIT LOCATION AND DESIGNATION

APPROXIMATE SCALE IN FEET



**FIGURE 6-7**  
**GEOPHYSICAL SURVEY AREA**  
**1949 PIT AREA**  
**PROPELLANT BURNING GROUND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**





**LEGEND**

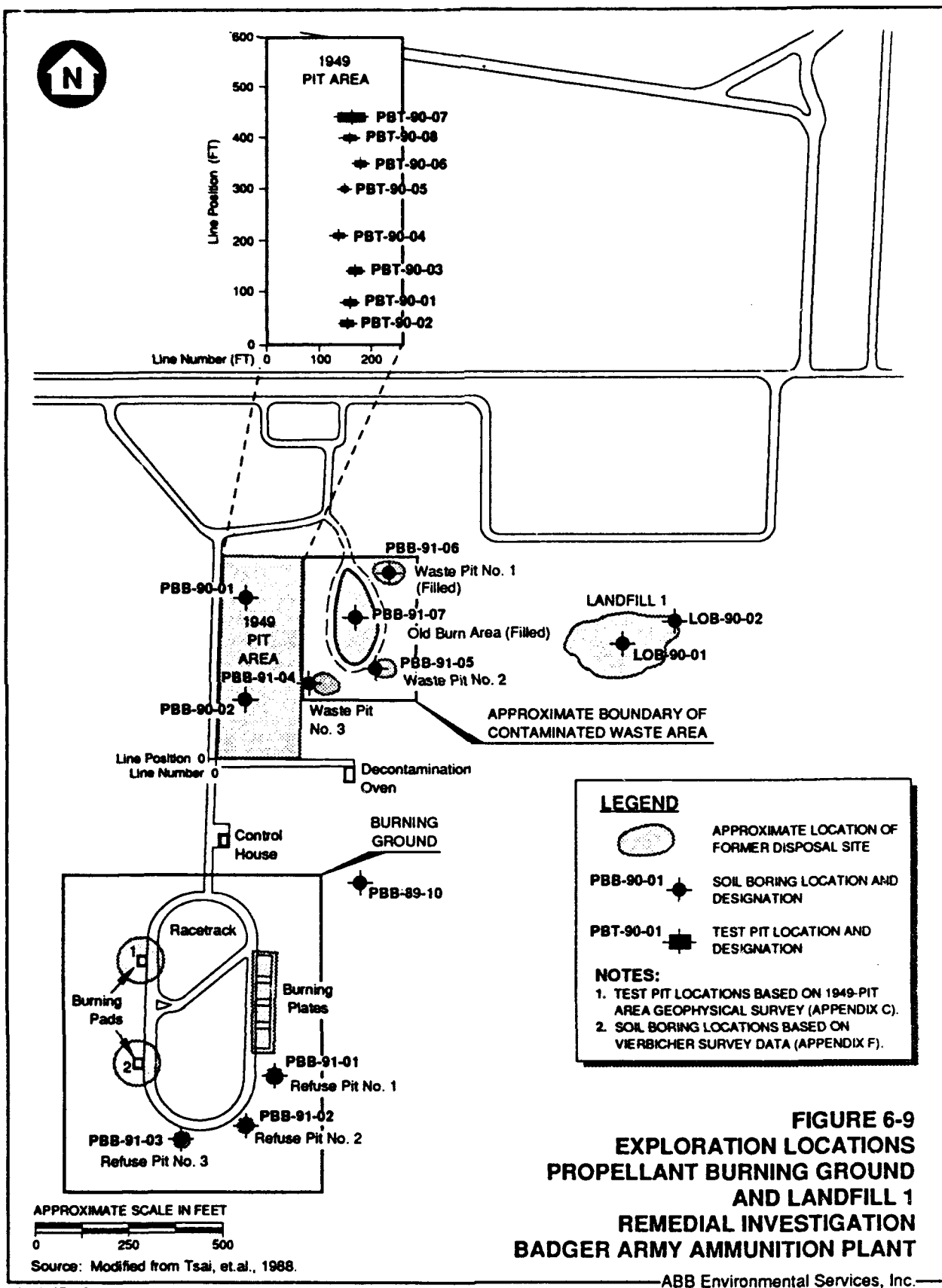
- • • TC SURVEY GRID POINTS
- GPR TRAVERSE
- CONCRETE/ASPHALT RUBBLE



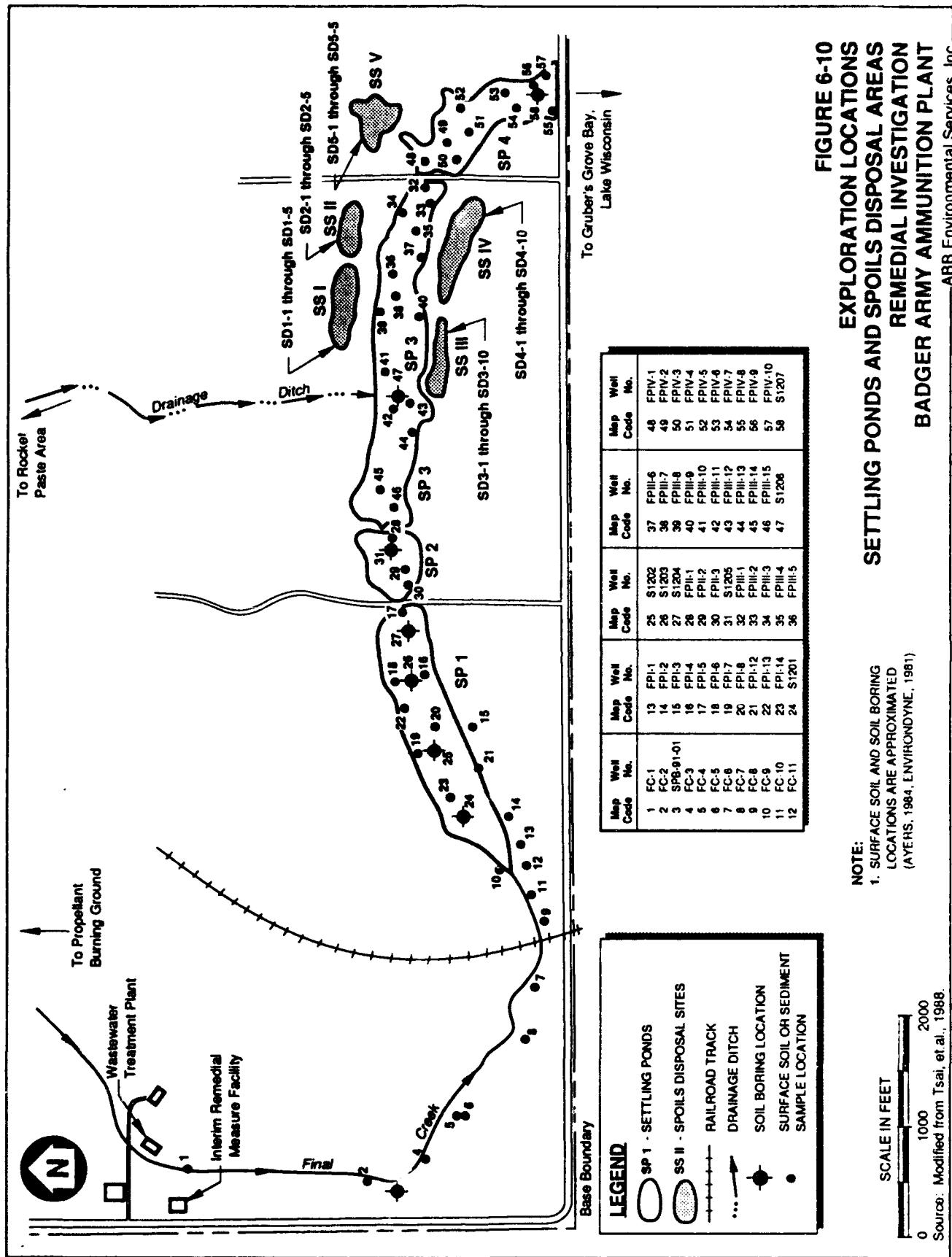
**FIGURE 6-8**  
**GEOPHYSICAL SURVEY AREA**  
**LANDFILL 1**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

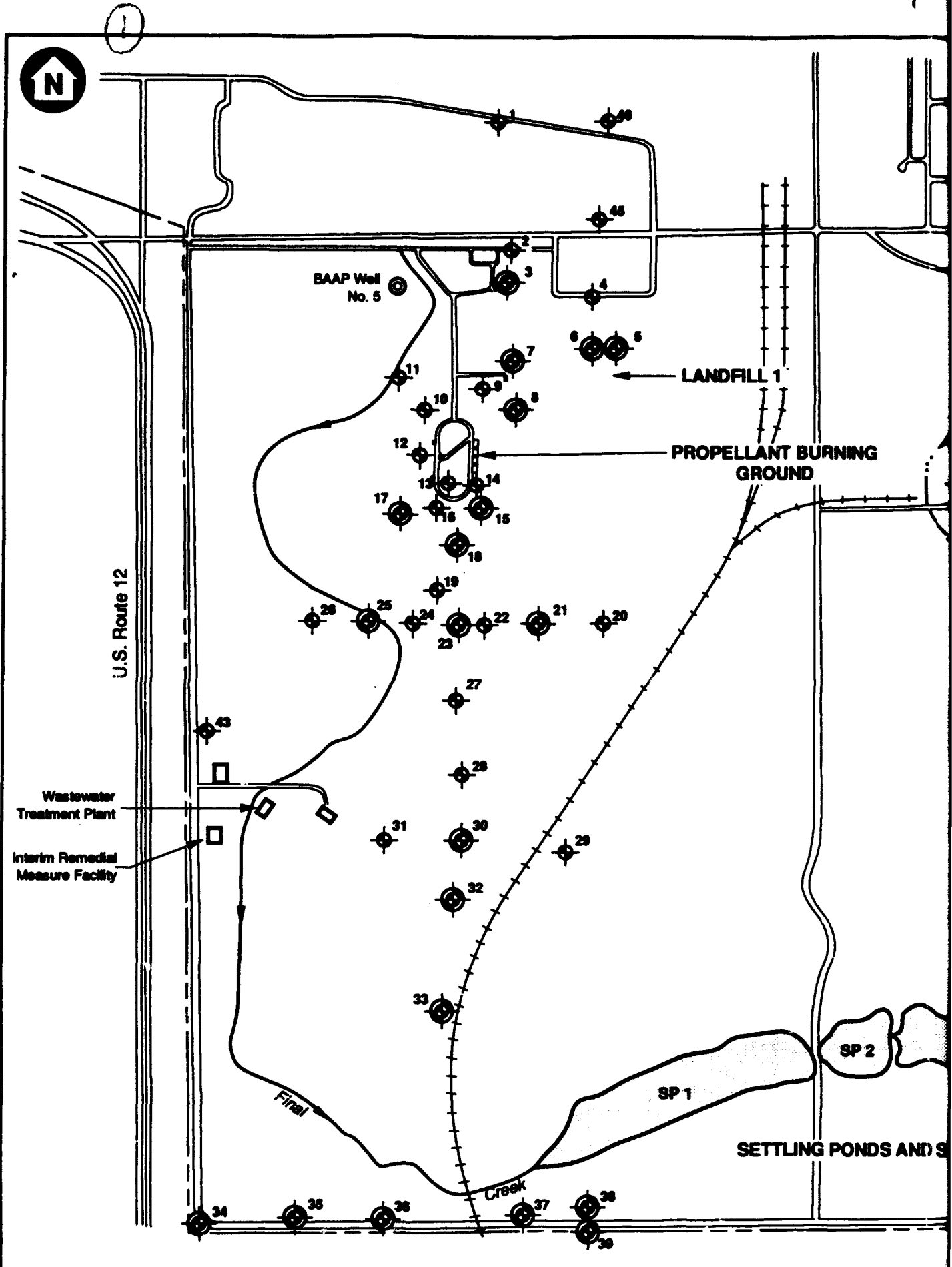














2

WEST ROCKET  
PASTE AREA

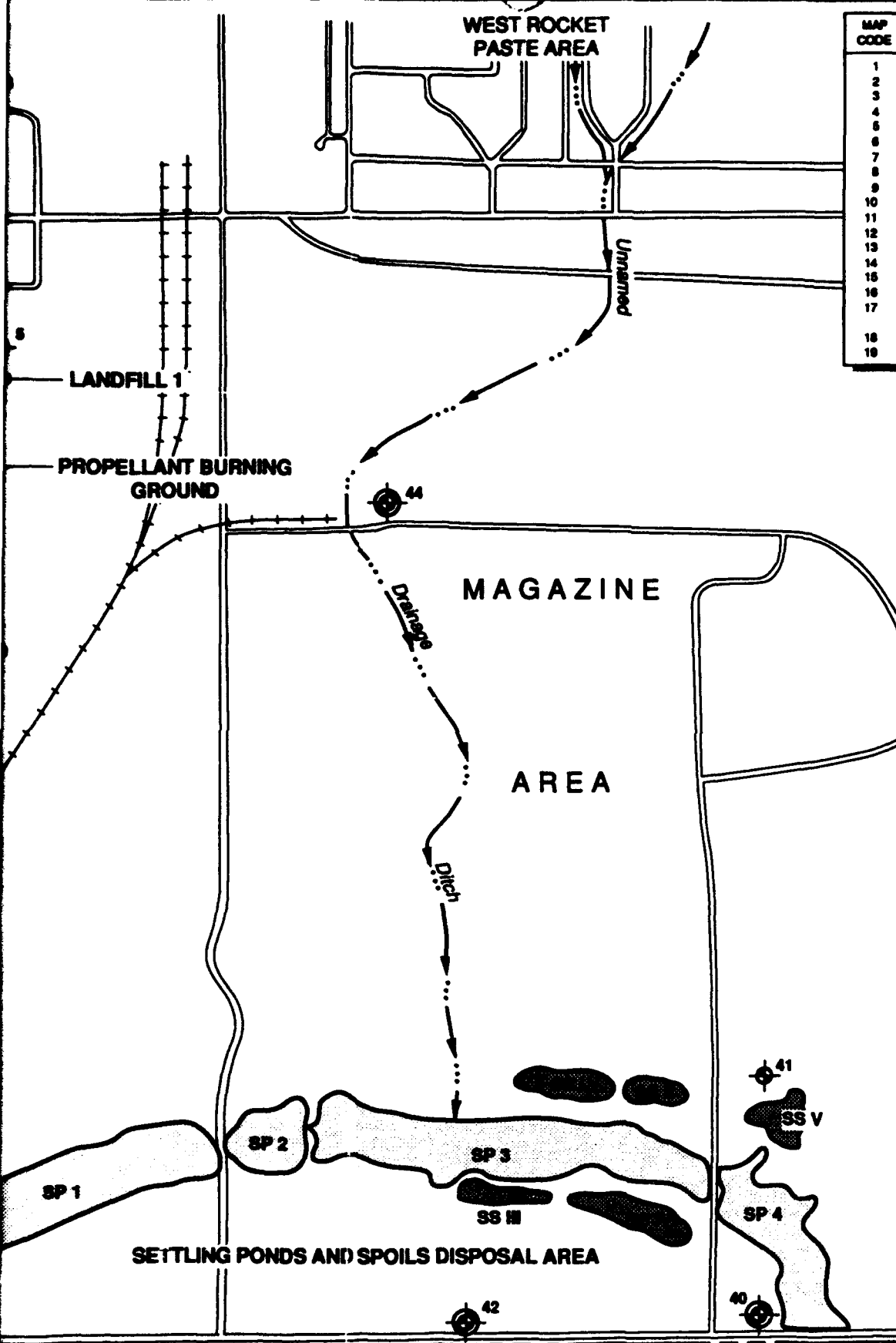
MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE
1	PEN-88-11	20	PEN-88-08	29
2	PEN-88-09	21	PEN-88-08BAC	30
3	PEN-88-01A,B,C		PEN-88-08A	31
4	LON-88-01	22	PEN-88-08	32
5	LON-88-03AAB	23	PEN-88-01B,C,AD	33
6	LON-88-03AAB		PEN-88-01A	34
7	PEN-88-03AB,C	24	PEN-88-02	35
8	PEN-88-10A,B,C,AD	25	PEN-88-03BAC	36
9	PEN-88-02		PEN-88-03A	37
10	S1144	26	PEN-88-05	38
11	PEN-88-01	27	PEN-88-04	39
12	PEN-88-03	28	PEN-88-05	40
13	PEN-88-04	29	PEN-88-06	41
14	PEN-88-05	30	PEN-88-04BAC	42
15	PEN-88-05A,B,C		PEN-88-04A	43
16	S1117	31	PEN-88-07	44
17	PEN-88-03A,B,C	32	PEN-88-08C,AD	45
18	S1148		PEN-88-08	46
19	PEN-88-04A,B,C	33	PEN-88-12AAB	47
20	PEN-88-01		PEN-88-12C,AD	48



**LEGEND**

- SP I SETTLING PONDS AREA AND DESIGNATION
- SS II SPOILS DISPOSAL AREA AND DESIGNATION
- 1 LOCATION OF SINGLE MONITORING WELL
- 3 LOCATION OF MONITORING WELL

- NOTES:**
1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION
  2. LOCATION OF S1100, 82, AND 85 SERIES MONITORING WELLS BASED ON SURVEY PROVIDED BY BAAP.
  3. LOCATION OF 89 AND 91 SERIES MONITORING WELLS BASED ON VIERBICHER SURVEY (APPENDIX F).



MONITORING WELL  
PROPELLANT BURNING

SETTLING  
SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION

ABB Environmental



CKET AREA

Unnamed

AZINE

REA





AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PEM-88-11	20	PEM-88-08	34	SPN-88-01C
2	PEM-88-09	21	PEM-88-08B&C		S1101 & S1139
3	PEM-88-01A,B,&C		PEM-88-08A	35	SPN-88-08A,B,&C
4	LCM-88-01	22	PEM-88-03		SPN-81-08D
5	LCN-88-03A&B	23	PEM-88-01B,C,&D	36	SPN-88-03B&C
6	LCN-88-02A&B		PEM-88-01A		SPN-81-03D
7	PEM-88-02A,B,&C	24	PEM-88-02		S1147
8	PEM-88-10A,B,C,&D	25	PEM-88-03B&C	37	SPN-88-04B&C
9	S1144		PEM-88-03A		S1148, SPN-81-04D
10	S1144	26	PEM-88-05	38	S1102, S1103, S1149
11	PEM-88-01	27	PEM-88-04	39	S1182A&B
12	PEM-88-03	28	PEM-88-05	40	SPN-88-05A&B
13	PEM-88-04	29	PEM-88-08	41	S1110
14	PEM-88-05	30	PEM-88-04B&C	42	S1104, S1105, S1108
15	PEM-88-05A,B,&C		PEM-88-04A	43	S1109
16	S1117	31	PEM-88-07	44	S1115, S1116
17	PEM-88-03A,B,&C	32	PEM-81-08C&D	45	LCM-81-01
	S1148		PEM-88-08	46	LCM-81-02
18	PEM-88-04A,B,&C	33	PEM-88-12A&B		
19	PEM-88-01		PEM-81-12C&D		

APPROXIMATE SCALE IN FEET

0 1000 2000

### LEGEND

- SP 1  SETTLING PONDS AREA AND DESIGNATION
- SS II  SPOILS DISPOSAL AREA AND DESIGNATION
- 1  LOCATION OF SINGLE MONITORING WELL
- 3  LOCATION OF MONITORING WELL NEST

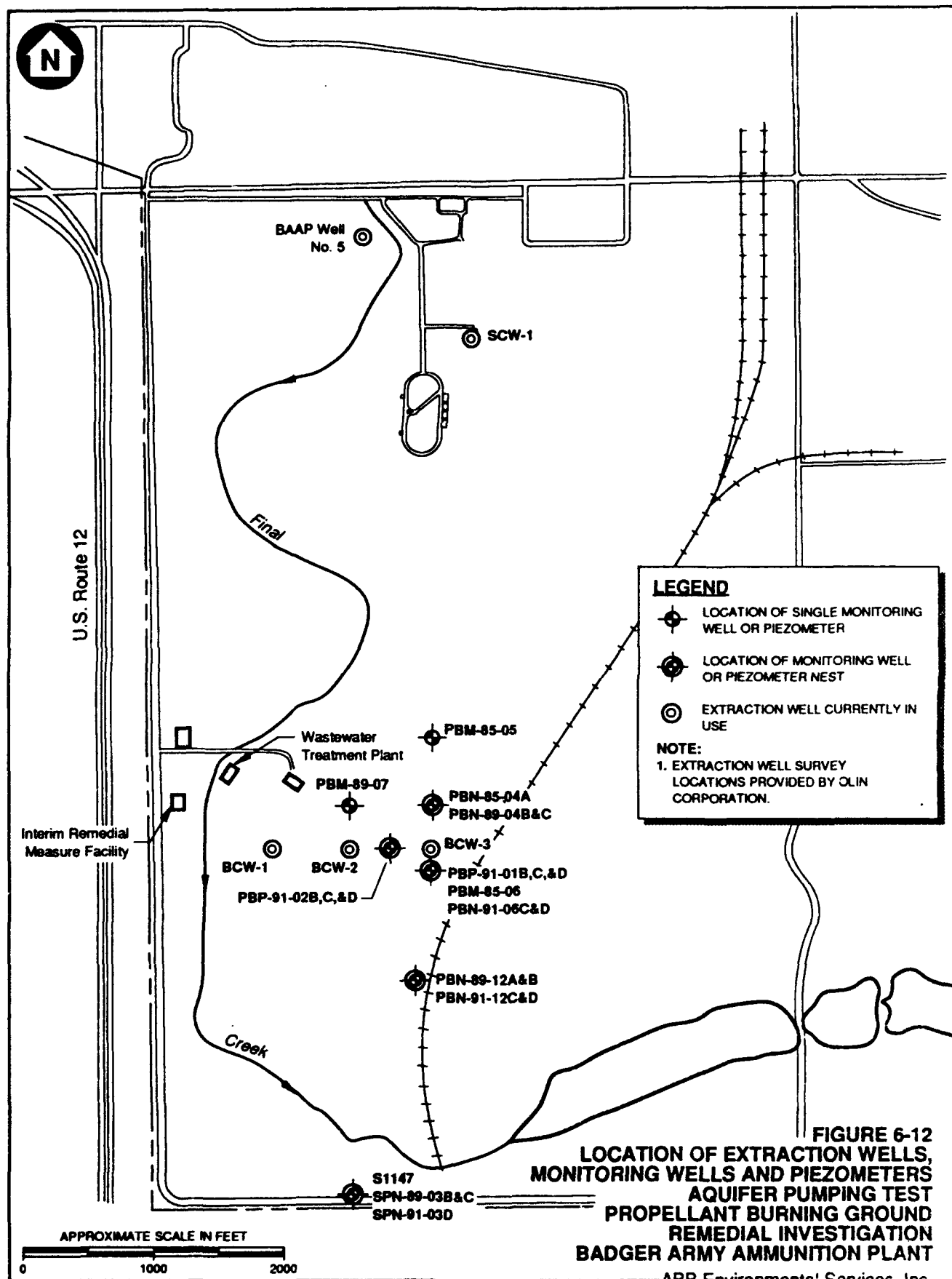
### NOTES:

1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. LOCATION OF S1100, 82, AND 85 SERIES MONITORING WELLS BASED ON SURVEY DATA PROVIDED BY BAAP.
3. LOCATION OF 89 AND 91 SERIES MONITORING WELLS BASED ON VIERBICHER SURVEY DATA (APPENDIX F).

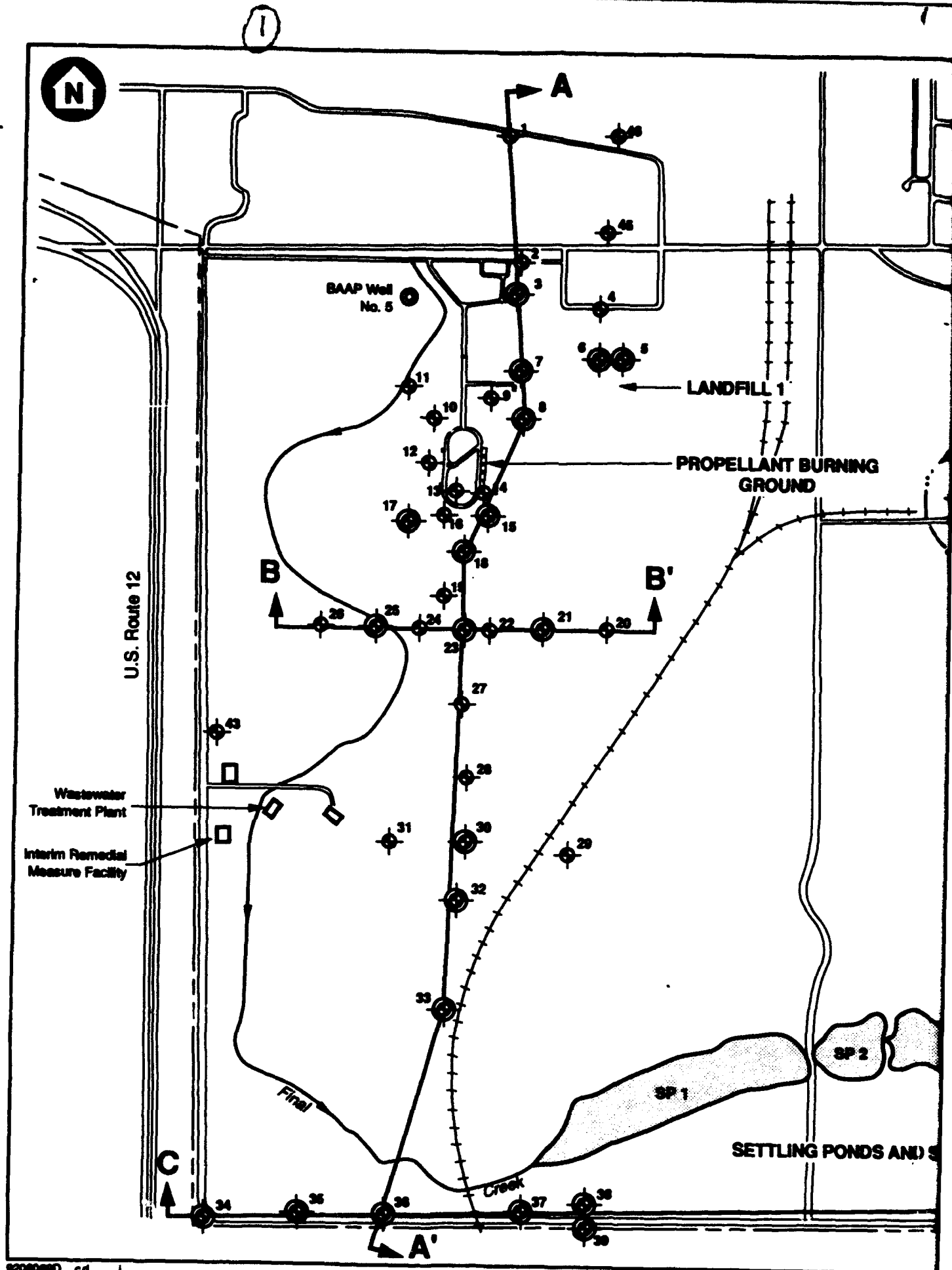
**FIGURE 6-11**  
**MONITORING WELL LOCATIONS**  
**PROPELLANT BURNING GROUND,**  
**LANDFILL 1,**  
**SETTLING PONDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.











2





WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE
1	PBM-00-11	20	PBM-00-08	20
2	PBM-00-09	21	PBM-00-08BAC	20
3	PBM-00-01A,B,C		PBM-00-08A	20
4	LCM-00-01	22	PBM-00-09	20
5	LCM-00-02A,B	23	PBM-00-01B,C,D	20
6	LCM-00-02A,B		PBM-00-01A	20
7	PBM-00-02A,B,C	24	PBM-00-02	20
8	PBM-00-02A,B,C,D	25	PBM-00-02BAC	20
9	PBM-00-02		PBM-00-02A	20
10	S1144	26	PBM-00-03	20
11	PBM-00-01	27	PBM-00-04	20
12	PBM-00-03	28	PBM-00-05	20
13	PBM-00-04	29	PBM-00-06	20
14	PBM-00-05	30	PBM-00-06BAC	20
15	PBM-00-06A,B,C		PBM-00-06A	20
16	S1117	31	PBM-00-07	20
17	PBM-00-06A,B,C	32	PBM-01-08C,D	20
18	S1146		PBM-00-08	20
19	PBM-00-04A,B,C	33	PBM-00-12A,B	20
19	PBM-00-01		PBM-01-12C,D	20

APPROXIMATE

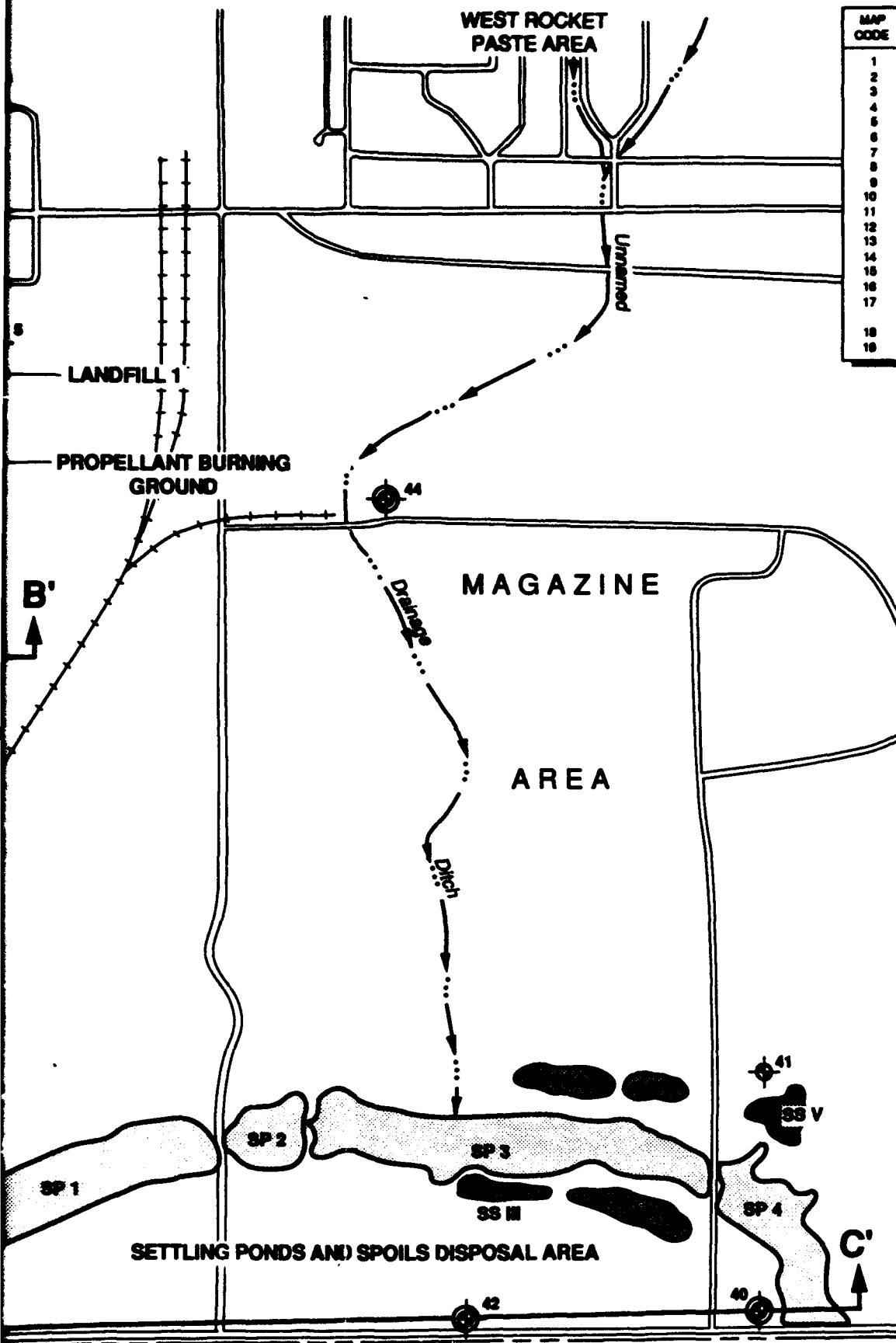
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**LEGEND**

- SP 1  SETTLING PONDS AREA AND DESIGNATION
- SS II  SPOILS DISPOSAL AREA AND DESIGNATION
- 1  LOCATION OF SINGLE MONITORING WELL
- 3  LOCATION OF MONITORING WELL

**NOTE:**

1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION

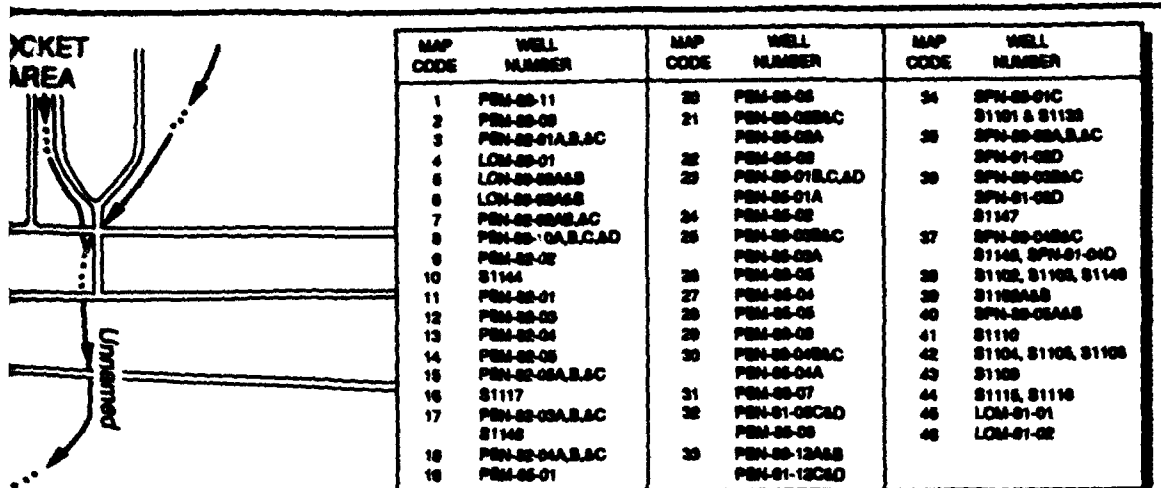


LOCATION AND ORIE  
GEOLOGIC CROSS  
PROPELLANT BURNING

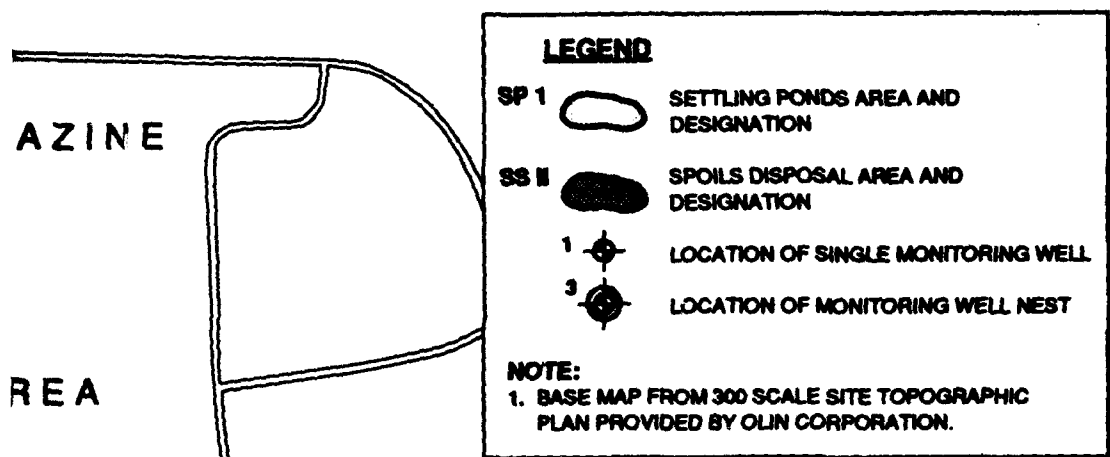
SETTLING  
SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

ABB Environmental





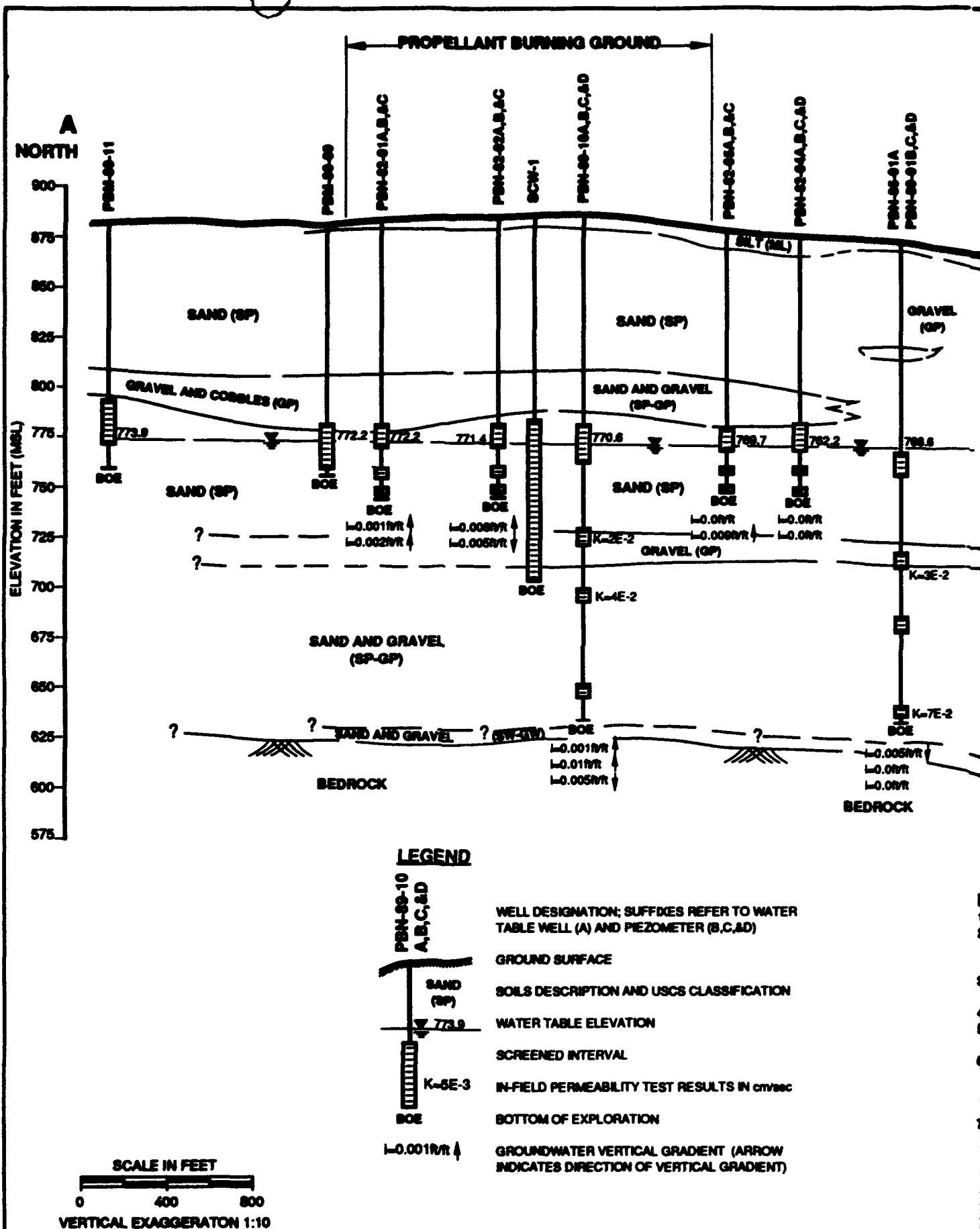
APPROXIMATE SCALE IN FEET  
0 1000 2000



**FIGURE 6-13**  
**LOCATION AND ORIENTATION OF**  
**GEOLOGIC CROSS SECTIONS**  
**PROPELLANT BURNING GROUND,**  
**LANDFILL 1,**  
**SETTLING PONDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

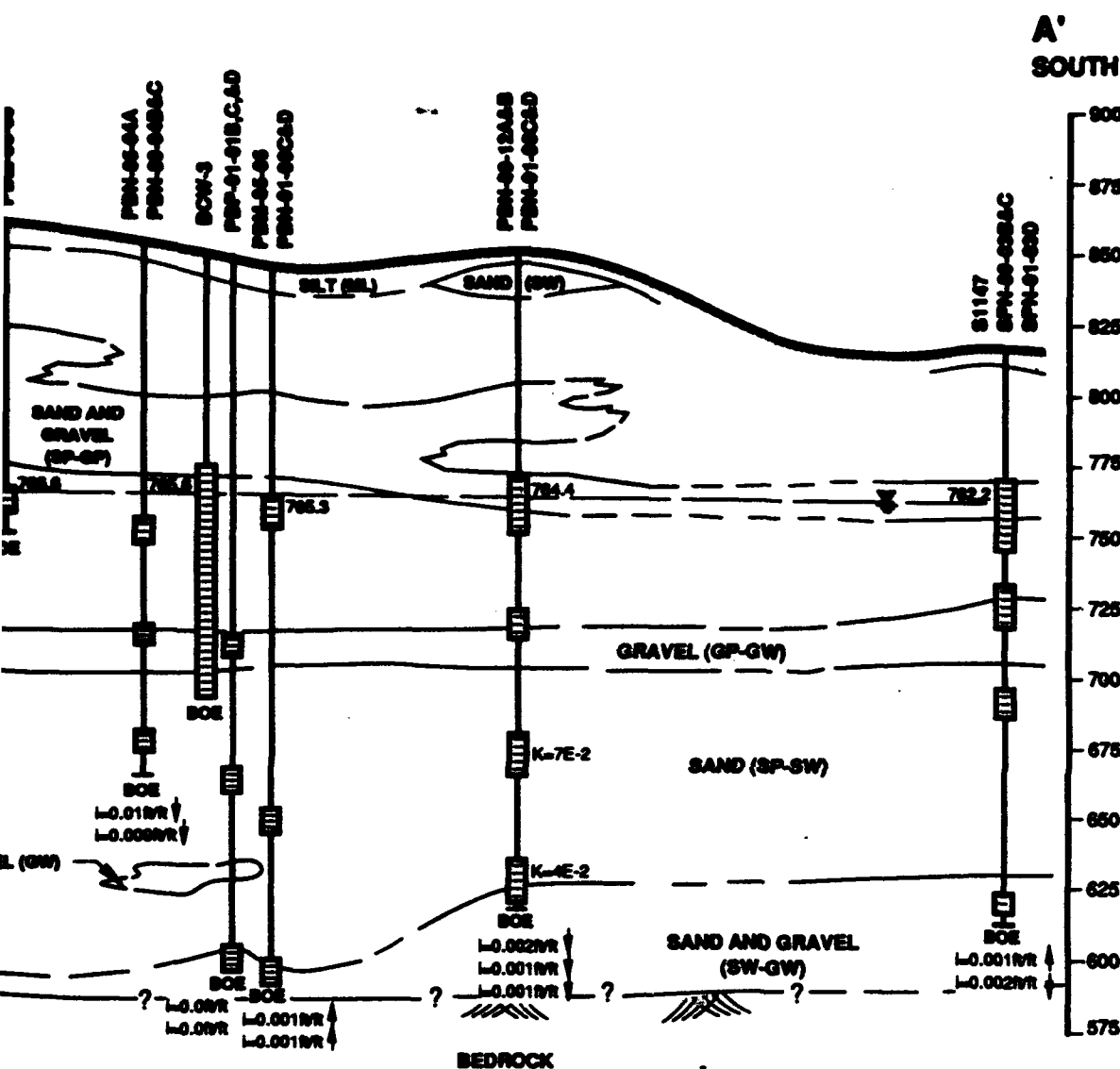






## -ABB Environment

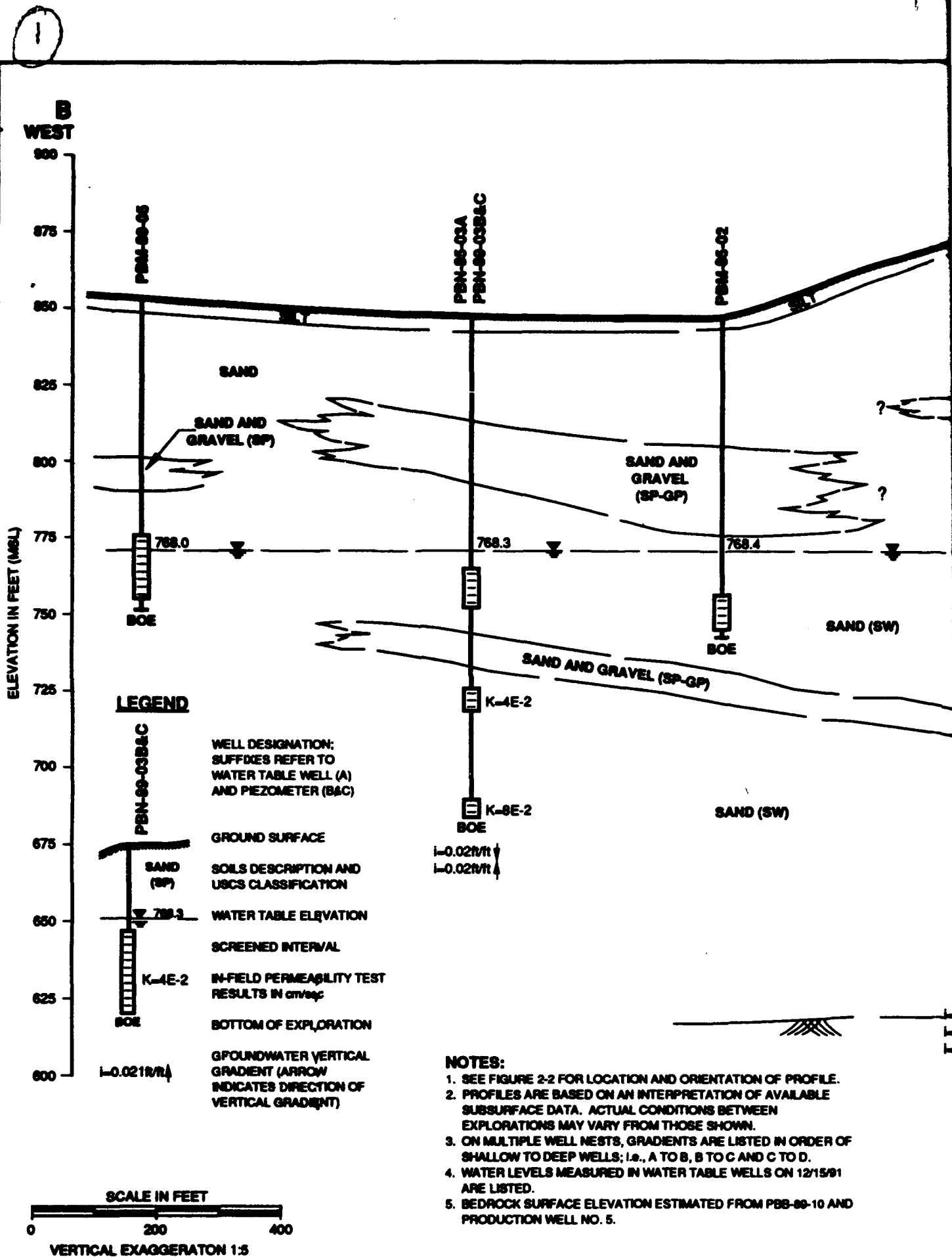




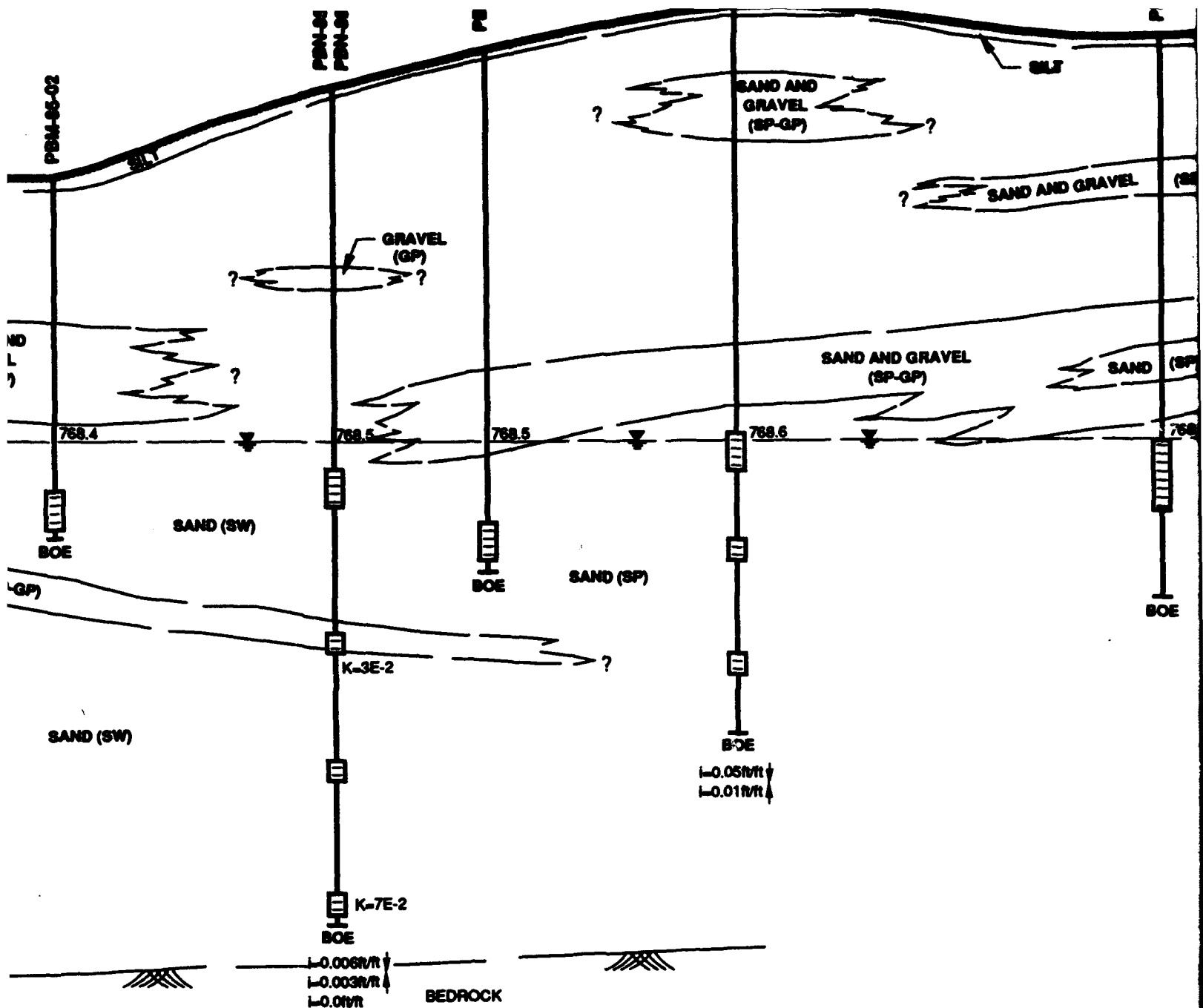
LOCATION AND ORIENTATION OF PROFILE.  
ON AN INTERPRETATION OF AVAILABLE SUBSURFACE  
DATA. DIRECTIONS BETWEEN EXPLORATIONS MAY VARY FROM  
NORTH TO SOUTH, GRADIENTS ARE LISTED IN ORDER OF SHALLOW  
TO DEEP, B TO C AND C TO D.  
ELEVATIONS IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.  
ELEVATION ESTIMATED FROM PBN-01-10 AND  
PBN-01-12D.  
ELEVATION ESTIMATED FROM PBN-01-12D (LOCATED  
APPROXIMATELY 1200 FEET  
NORTH OF PBN-01-10).  
USED ONLY FOR GEOLOGIC INFORMATION AND AQUIFER  
MONITORING WELL CLUSTER.

**FIGURE 6-14**  
**GEOLOGIC CROSS SECTION A-A'**  
**PROPELLANT BURNING GROUND,**  
**SETTLING POINDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**









ORIENTATION OF PROFILE.  
RETENTION OF AVAILABLE  
TIONS BETWEEN  
DSE SHOWN.  
ITS ARE LISTED IN ORDER OF  
B, B TO C AND C TO D.  
R TABLE WELLS ON 12/15/81

IMATED FROM PBB-89-10 AND

**GEOLOGIC CROSS SECTION  
PROPELLANT BURNING  
SETTLING PONDS AND SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental**



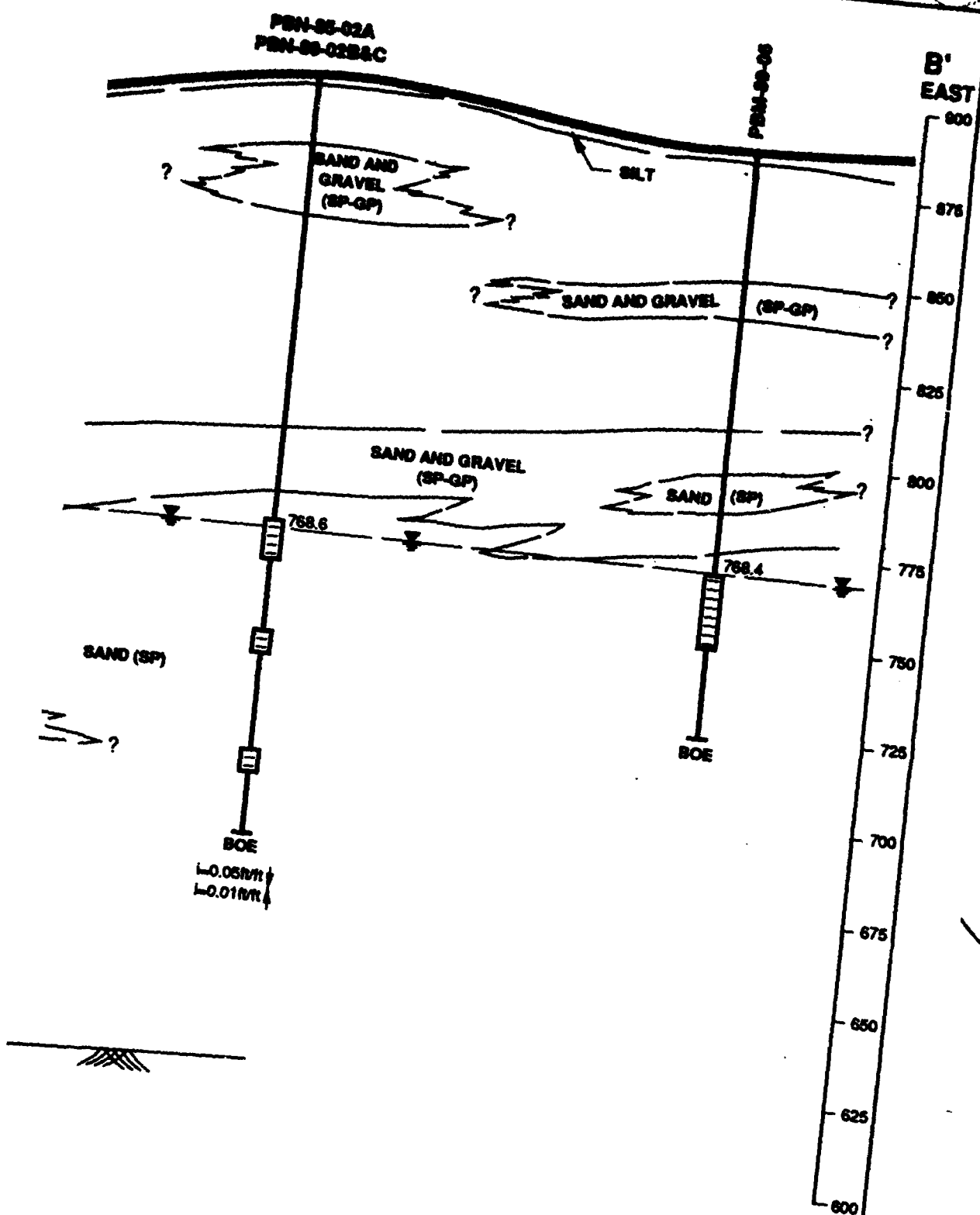
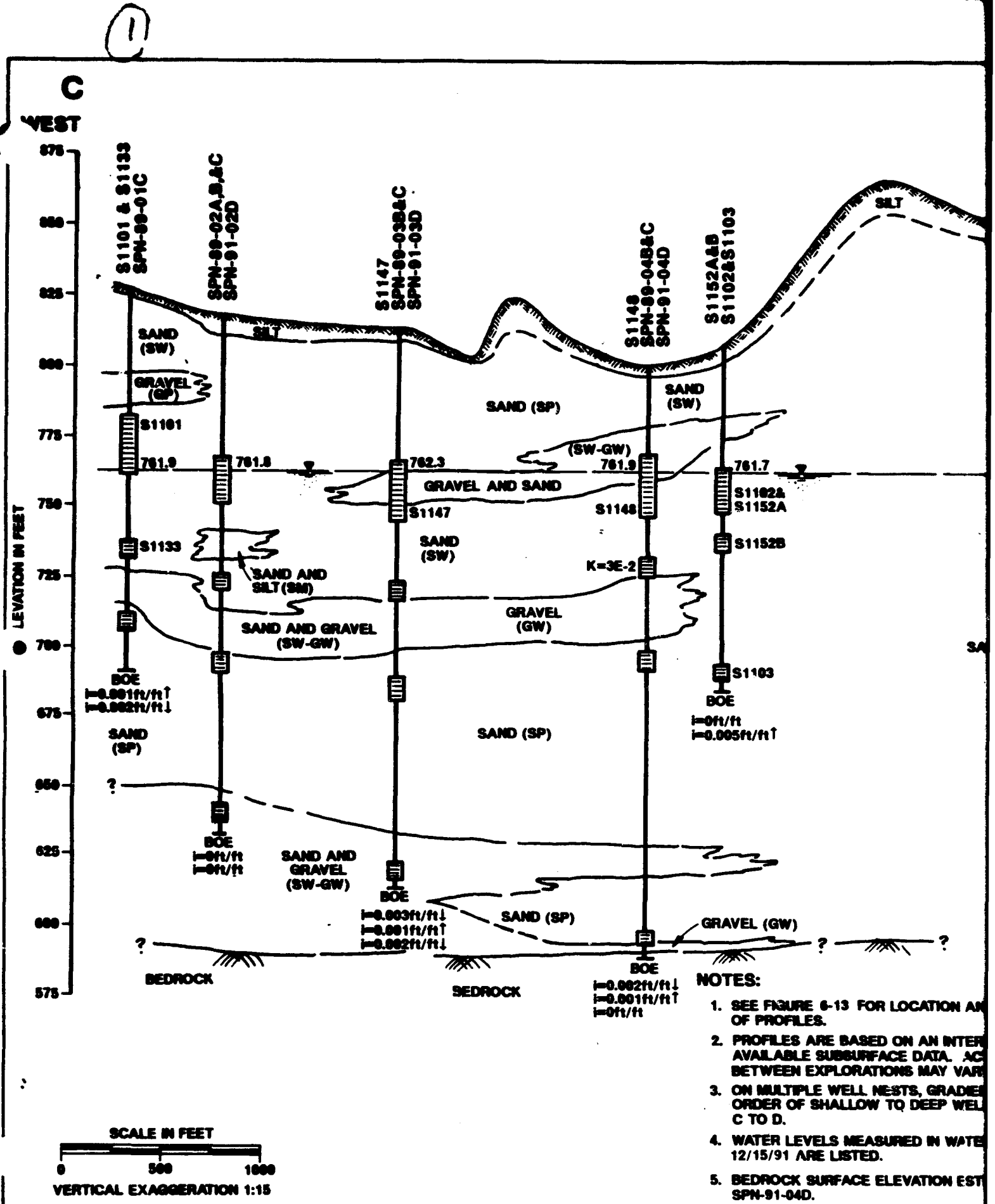


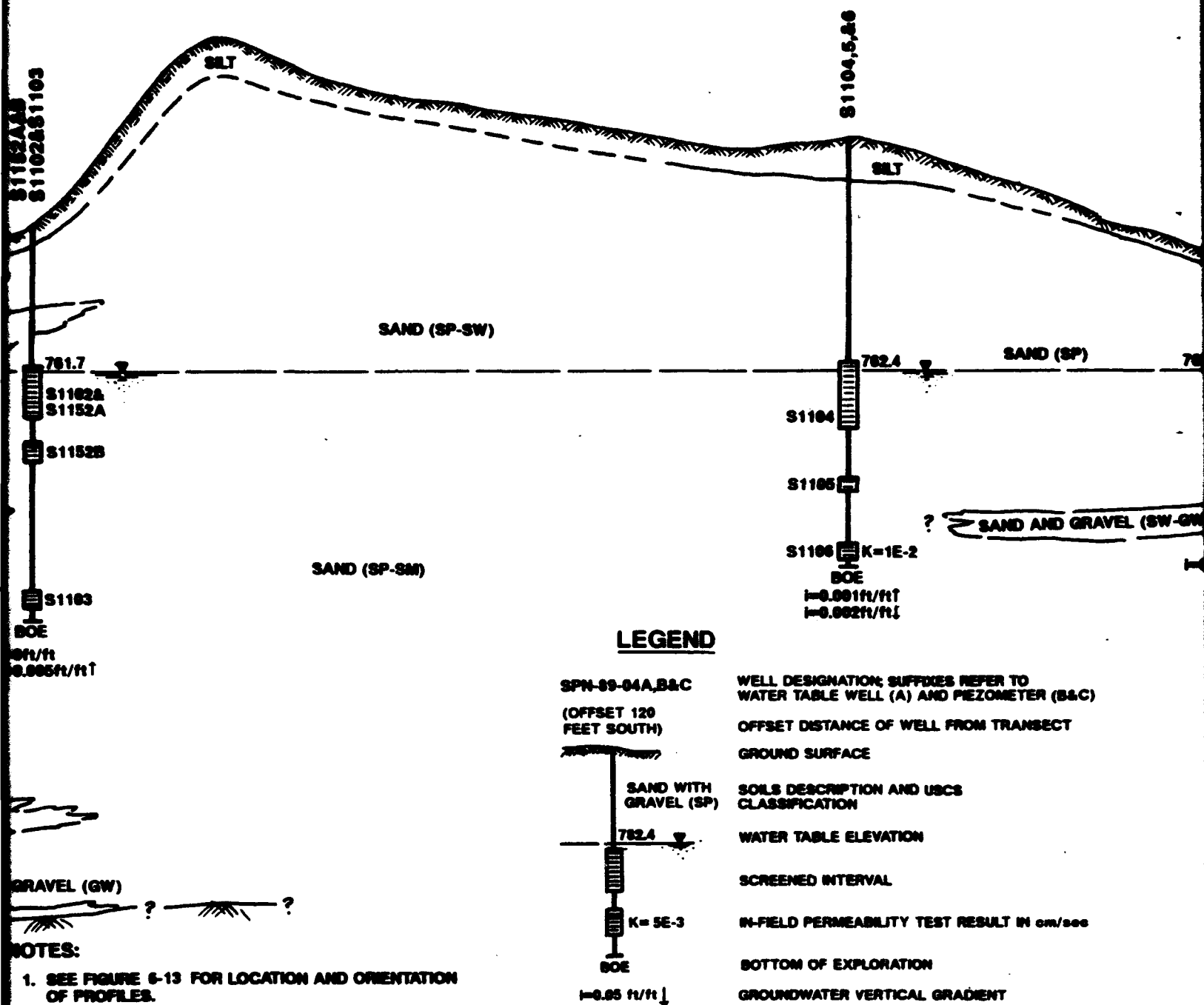
FIGURE 6-15  
 GEOLOGIC CROSS SECTION B-B'  
 PROPELLANT BURNING GROUND,  
 SETTLING PONDS AND SPOILS DISPOSAL AREA  
 REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT  
 ABB Environmental Services, Inc.







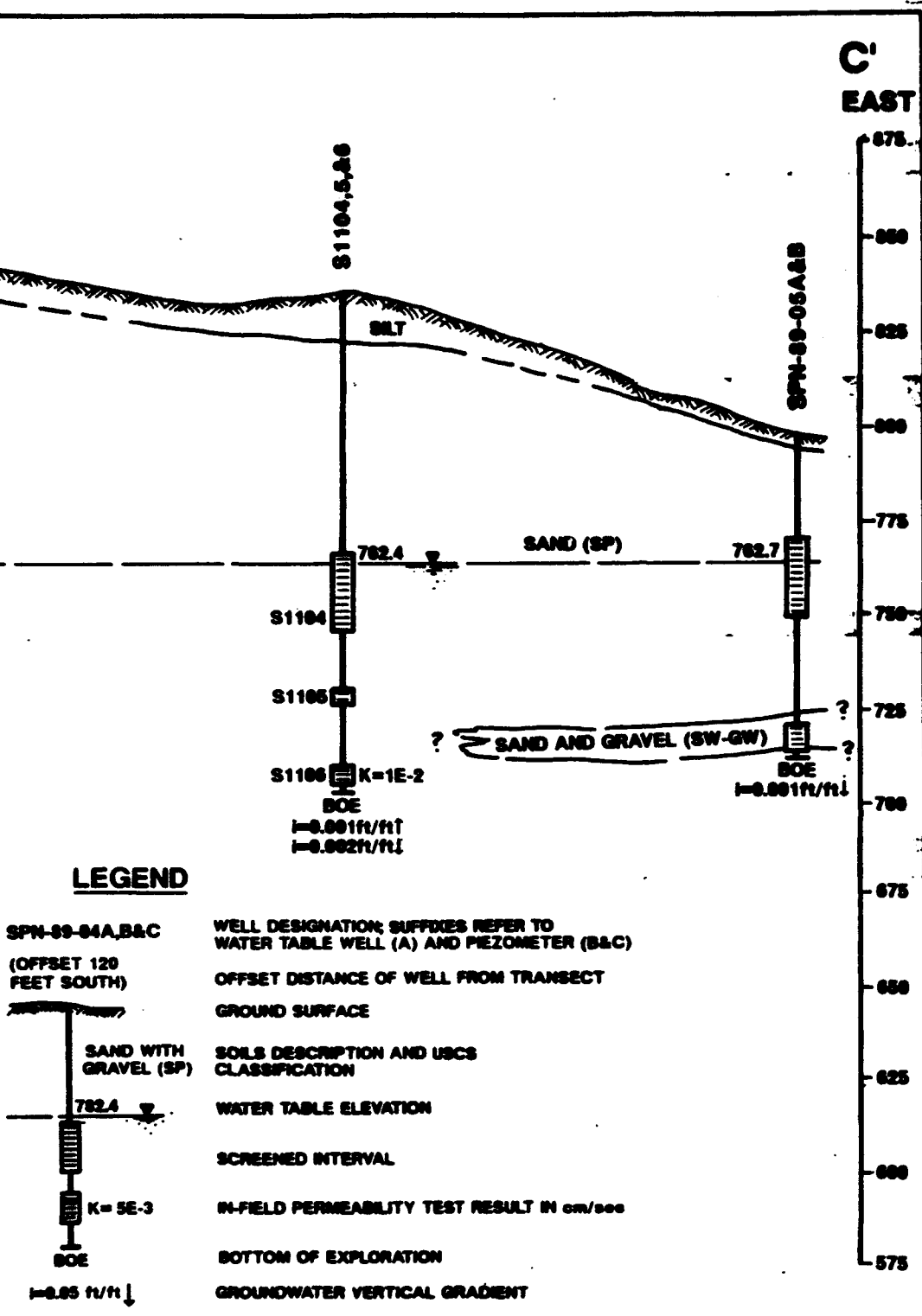
(2) ✓



- NOTES:**
1. SEE FIGURE 6-13 FOR LOCATION AND ORIENTATION OF PROFILES.
  2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
  3. ON MULTIPLE WELL NESTS, GRADIENTS ARE LISTED IN ORDER OF SHALLOW TO DEEP WELLS, I.e., A TO B, B TO C, C TO D.
  4. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
  5. BEDROCK SURFACE ELEVATION ESTIMATED FROM SPN-91-04D.

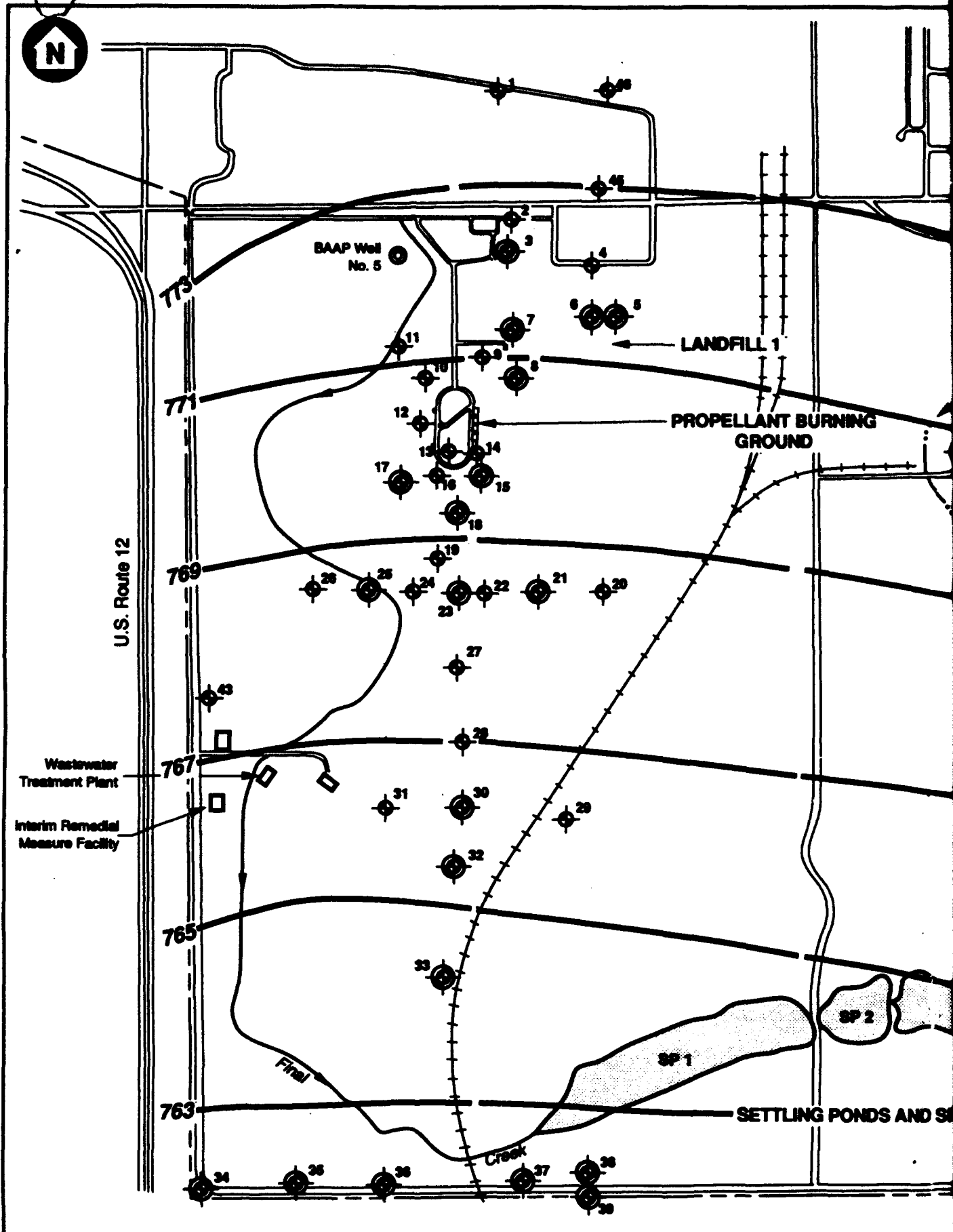
**FIGURE 6**  
**GEOLOGIC CROSS SECTION**  
**PROPELLANT BURNING GROUP**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
**ABS Environmental Services**





**FIGURE 6-16**  
**GEOLOGIC CROSS SECTION C-C'**  
**PROPELLANT BURNING GROUND,**  
**SETTLING PONDS AND SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.












WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER
1	PEN-02-11	773.90	20	PEN-02-06	768.20	34	SPN-02-04
2	PEN-02-09	772.17	21	PEN-02-02BAC	768.80	35	SPN-02-02
3	PEN-02-01A,B,C	772.22		PEN-02-02A	768.80		SPN-02-02
4	LOM-02-01	771.74	22	PEN-02-03	768.45	36	SPN-01-02
5	LOM-02-03A,B	771.11	23	PEN-02-01B,C,D		38	SPN-02-02
6	LOM-02-03A,B	771.35		PEN-02-01A	768.60		SPN-01-02
7	PEN-02-02A,B,C	771.30	24	PEN-02-02	768.35		S1147
8	PEN-02-10A,B,C,D	770.61	25	PEN-02-02BAC		37	SPN-02-04
9	PEN-02-02	771.24		PEN-02-02A	768.20		S1148, SPN
10	S1144	770.84	26	PEN-02-05	768.05	38	S1102, S11
11	PEN-02-01	771.23	27	PEN-02-04	767.75	39	S1102A,B
12	PEN-02-03	770.28	28	PEN-02-05	768.05	40	SPN-02-02
13	PEN-02-04	768.95	29	PEN-02-08	768.10	41	S1110
14	PEN-02-05	770.05	30	PEN-02-04BAC		42	S1104, S11
15	PEN-02-05A,B,C	768.72		PEN-02-04A	768.61	43	S1109
16	S1117	770.85	31	PEN-02-07	762.40	44	S1115, S11
17	PEN-02-03A,B,C	768.90	32	PEN-01-02C,D		45	LOM-01-01
18	PEN-02-04A,B,C	768.19		PEN-02-02	768.30	46	LOM-01-02
19	PEN-02-01	768.89	33	PEN-02-12A,B	764.43		
				PEN-01-12C,D			

APPROXIMATE SCALE

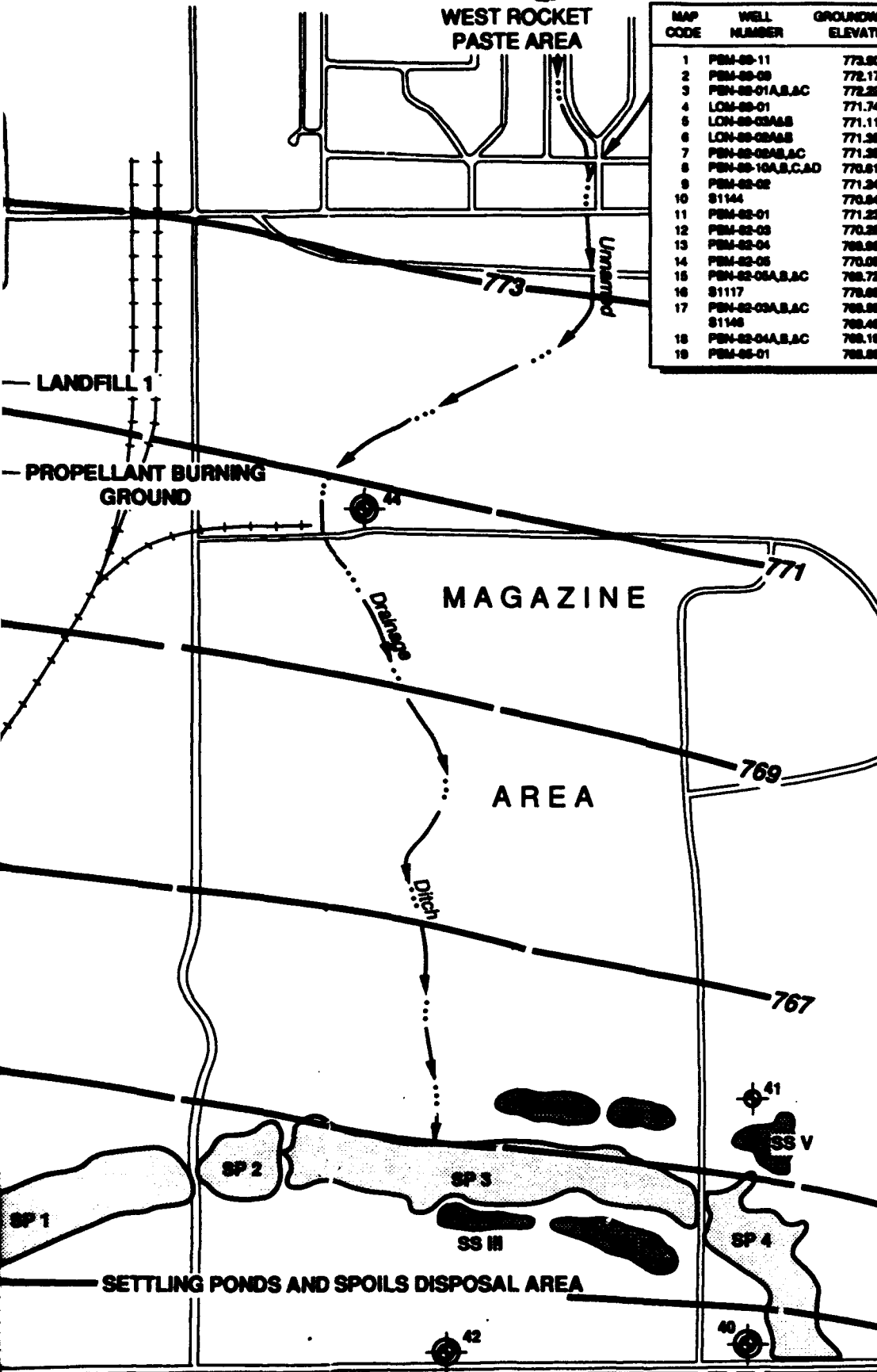
0 1000

LEGEND

- SP 1  SETTLING PONDS AREA AND DESIGNATION
- SS II  SPOILS DISPOSAL AREA AND DESIGNATION
- 1  LOCATION OF SINGLE MONITOR
- 3  LOCATION OF MONITORING WELL
- 771  CONTOUR LINE INDICATING APPROXIMATE WATER TABLE ELEVATION

NOTES:

1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHIC PROVIDED BY OLIN CORPORATION.
2. TOPOGRAPHIC CONTOUR INTERVAL 2 FEET.
3. WATER LEVELS MEASURED ON 12/15/91.
4. WELL SURVEY BASED ON U.S. COASTAL AND GEODETIC SURVEY DATUM. SURVEY BY VIERBICHER ASSOCIATES.
5. WATER ELEVATION CONTOURS ARE INTERPOLATED BASED ON WATER TABLE AND/OR B SERIES MONITORING WELLS.



FOR INTERPRETATION OF WATER TABLE CONTOURS, SEE PROPELLANT BURNING GROUND, LANDFILL, SETTling POND, SPOILS DISPOSAL AREA, REMEDIAL INVESTIGATION, BADGER ARMY AMMUNITION SITE, ABB Environmental Services



MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION	MAP CODE	WELL NUMBER	GROUNDWATER ELEVATION
1	PBM-00-11	773.90	20	PBM-00-08	768.30	34	SPN-00-01C	
2	PBM-00-09	772.17	21	PBM-00-02BAC			S1101 & S1139	761.87
3	PBM-00-01A,B,C	772.28		PBM-00-02A	768.80	35	SPN-00-02A,B,C	761.82
4	LOM-00-01	771.74	22	PBM-00-05	768.45		SPN-01-02D	
5	LOM-00-02A&B	771.11	23	PBM-00-01B,C&D		36	SPN-00-02B&C	
6	LOM-00-02A&B	771.35		PBM-00-01A	768.60		SPN-01-02D	
7	PBM-00-02A&B,C	771.39	24	PBM-00-02	768.35		S1147	762.20
8	PBM-00-10A,B,C&D	770.61	25	PBM-00-02B&C		37	SPN-00-04B&C	761.87
9	PBM-00-02	771.24		PBM-00-02A	768.20		S1148, SPN-01-04D	
10	S1144	770.84	26	PBM-00-05	768.03	38	S1102, S1103, S1149	761.88
11	PBM-00-01	771.23	27	PBM-00-04	767.70	39	S1182A&B	761.85
12	PBM-00-03	770.28	28	PBM-00-05	768.08	40	SPN-00-02A&B	762.87
13	PBM-00-04	768.85	29	PBM-00-08	768.10	41	S1110	768.00
14	PBM-00-05	770.05	30	PBM-00-04B&C		42	S1104, S1105, S1108	762.20
15	PBM-00-05A,B,C	768.72		PBM-00-04A	768.81	43	S1109	768.74
16	S1117	778.88	31	PBM-00-07	762.40	44	S1115, S1116	770.81
17	PBM-00-02A,B,C	768.89	32	PBM-01-02C&D		45	LOM-01-01	772.82
	S1140	768.48		PBM-00-08	765.33	46	LOM-01-02	773.89
18	PBM-00-04A,B,C	768.19	33	PBM-00-12A&B	764.43			
19	PBM-00-01	768.89		PBM-01-12C&D				

APPROXIMATE SCALE IN FEET

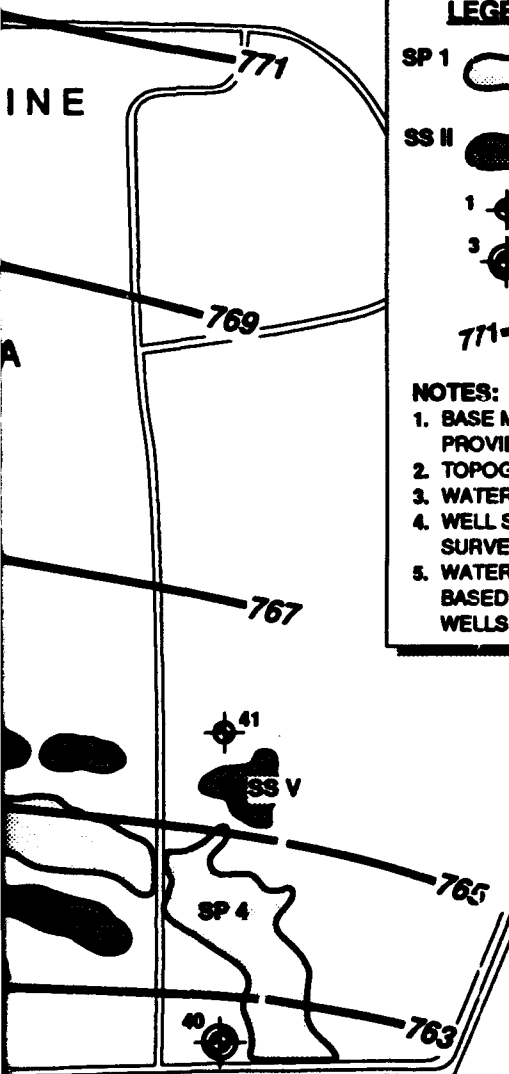


### LEGEND

- SP 1 SETTLING PONDS AREA AND DESIGNATION
- SS II SPOILS DISPOSAL AREA AND DESIGNATION
- 1 LOCATION OF SINGLE MONITORING WELL
- 3 LOCATION OF MONITORING WELL NEST
- 771 CONTOUR LINE INDICATING APPROXIMATE WATER TABLE ELEVATION

### NOTES:

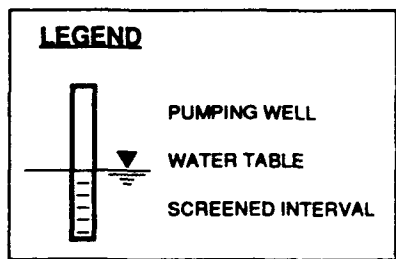
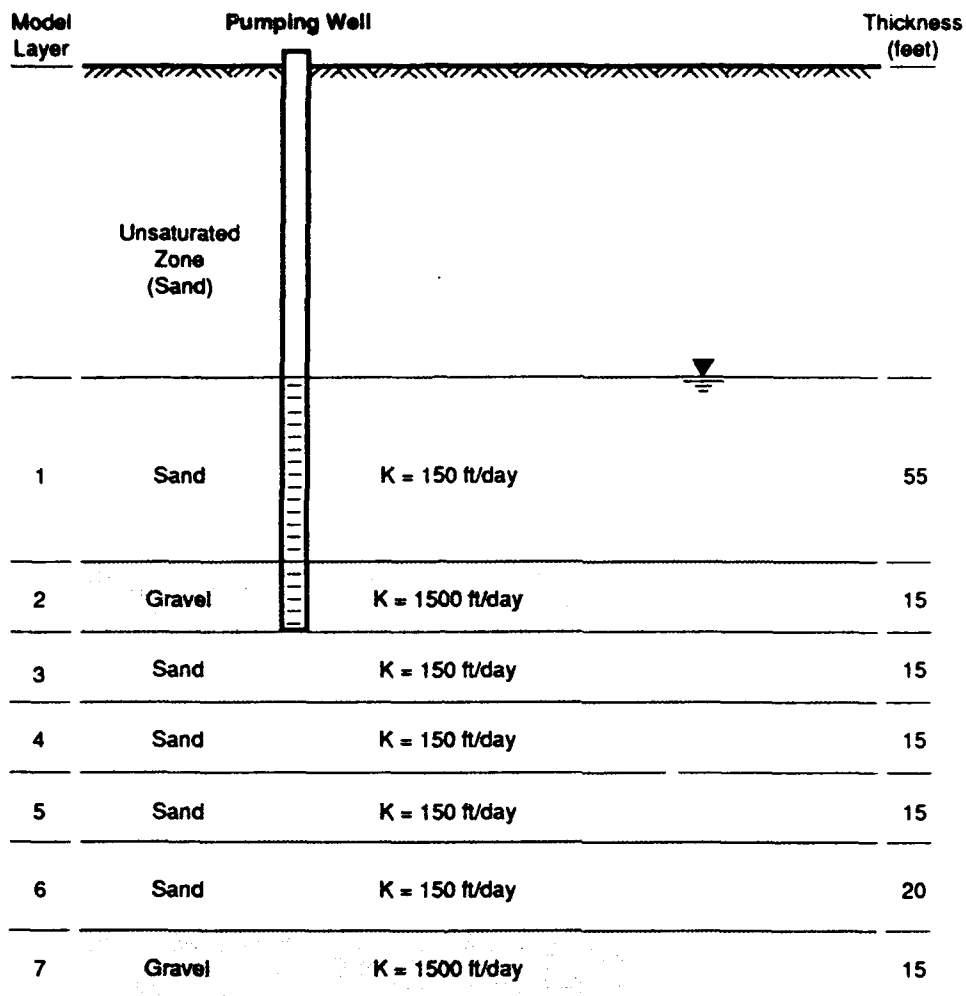
1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. TOPOGRAPHIC CONTOUR INTERVAL 2 FEET.
3. WATER LEVELS MEASURED ON 12/15/91.
4. WELL SURVEY BASED ON U.S. COASTAL AND GEODETIC SURVEY DATUM. SURVEY BY VIERBICHER ASSOC. (1989).
5. WATER ELEVATION CONTOURS ARE INTERPOLATED BASED ON WATER TABLE AND/OR B SERIES MONITORING WELLS.



**FIGURE 6-17**  
**INTERPRETIVE**  
**WATER TABLE CONTOUR PLAN**  
**PROPELLANT BURNING GROUND,**  
**LANDFILL 1,**  
**SETTLING PONDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





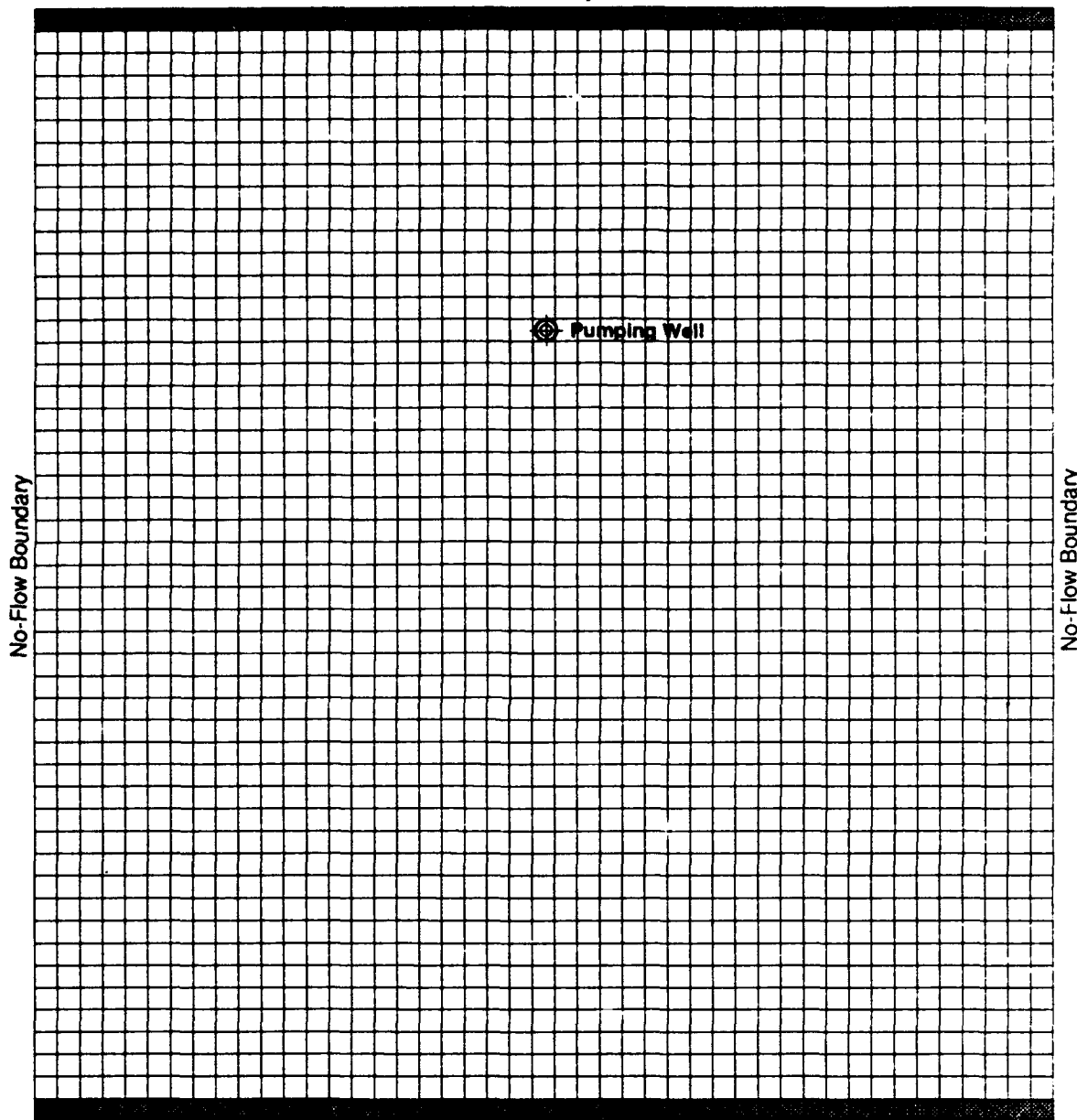
NOT TO SCALE

**FIGURE 6-18**  
**BOX MODEL LAYERS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.





Constant Head Boundary = 772 FT MSL



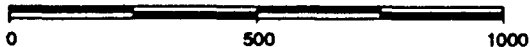
Constant Head Boundary = 769 FT MSL

**LEGEND**



CONSTANT HEAD CELL

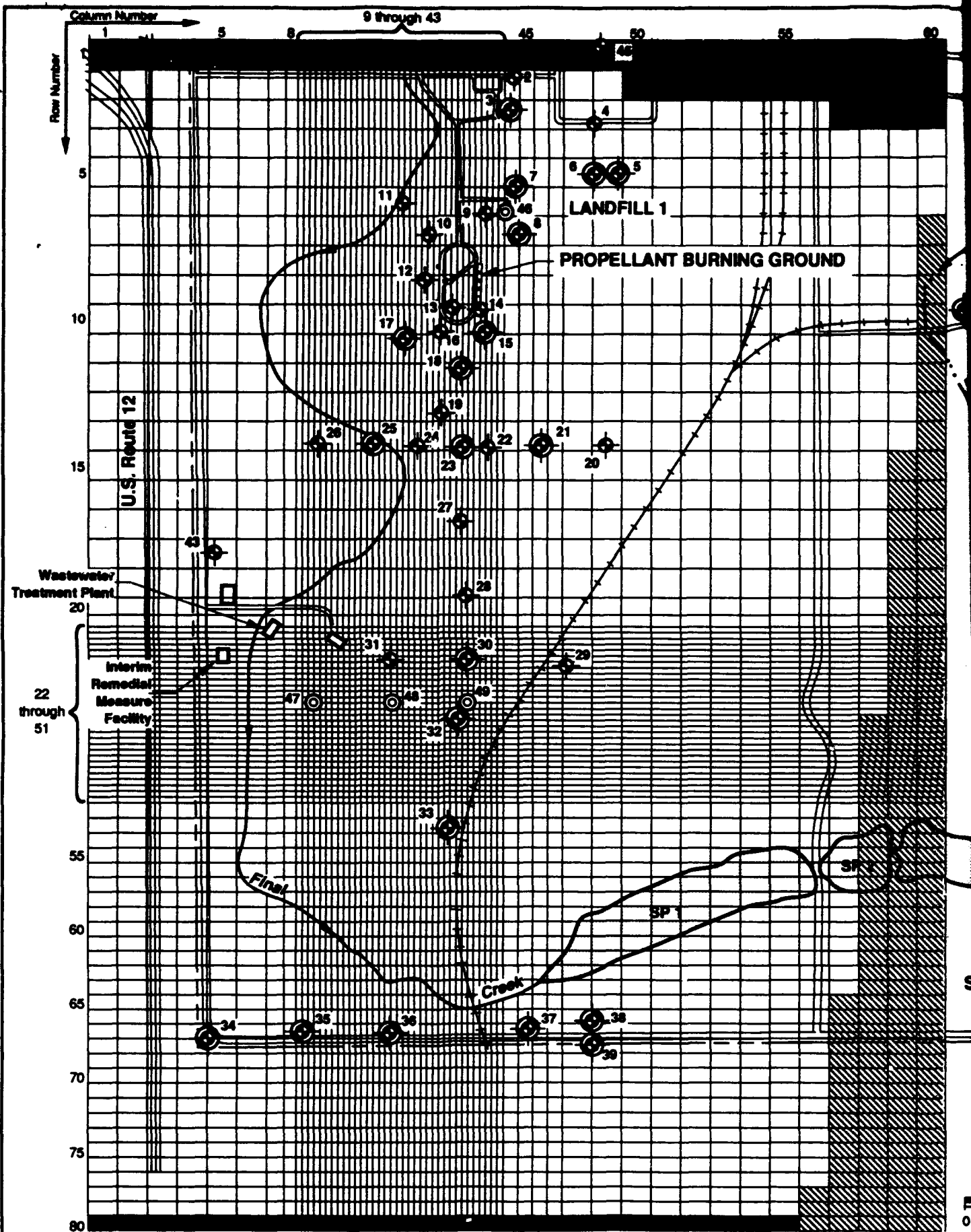
SCALE IN FEET



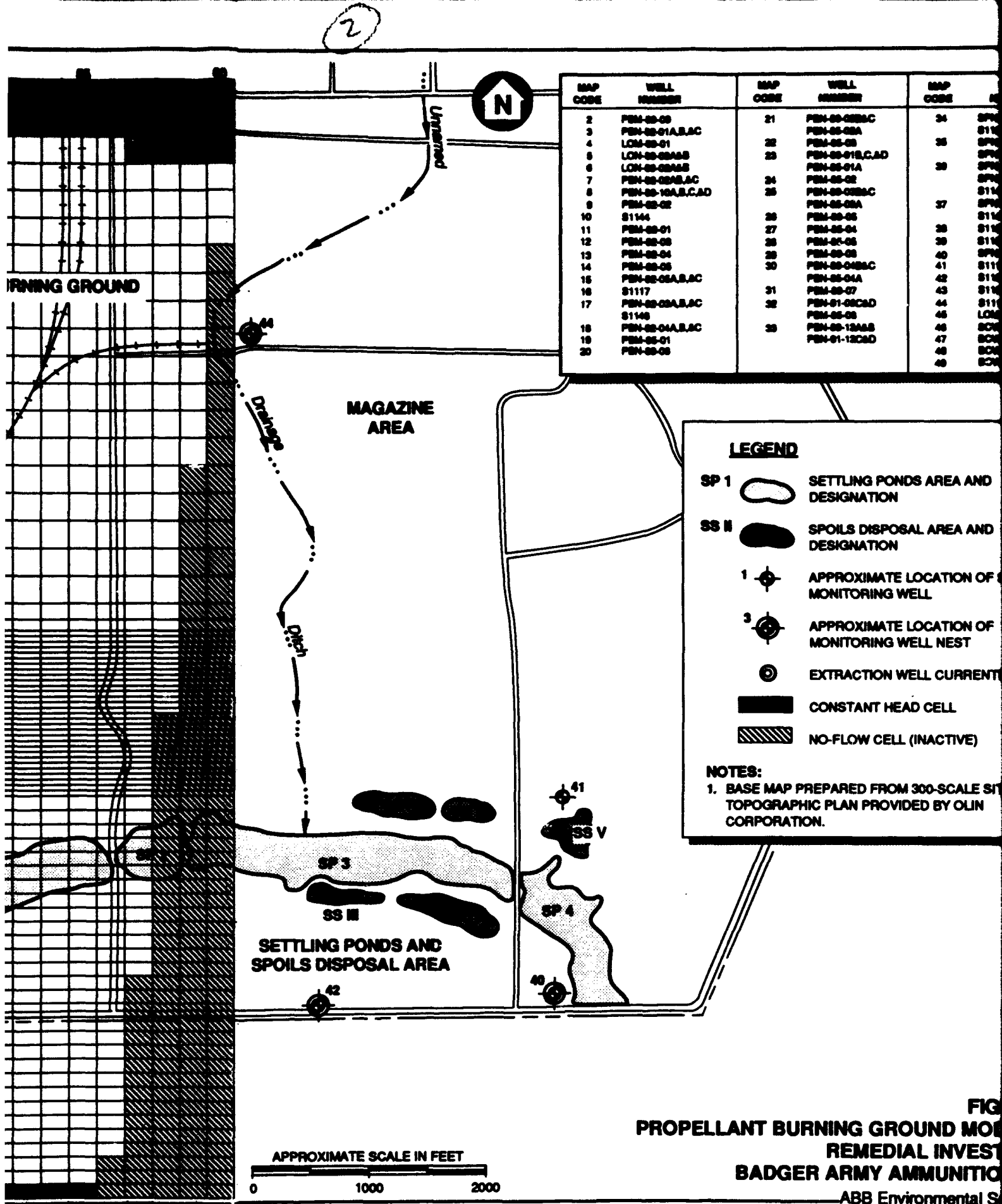
**FIGURE 6-19**  
**BOX MODEL GRID**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

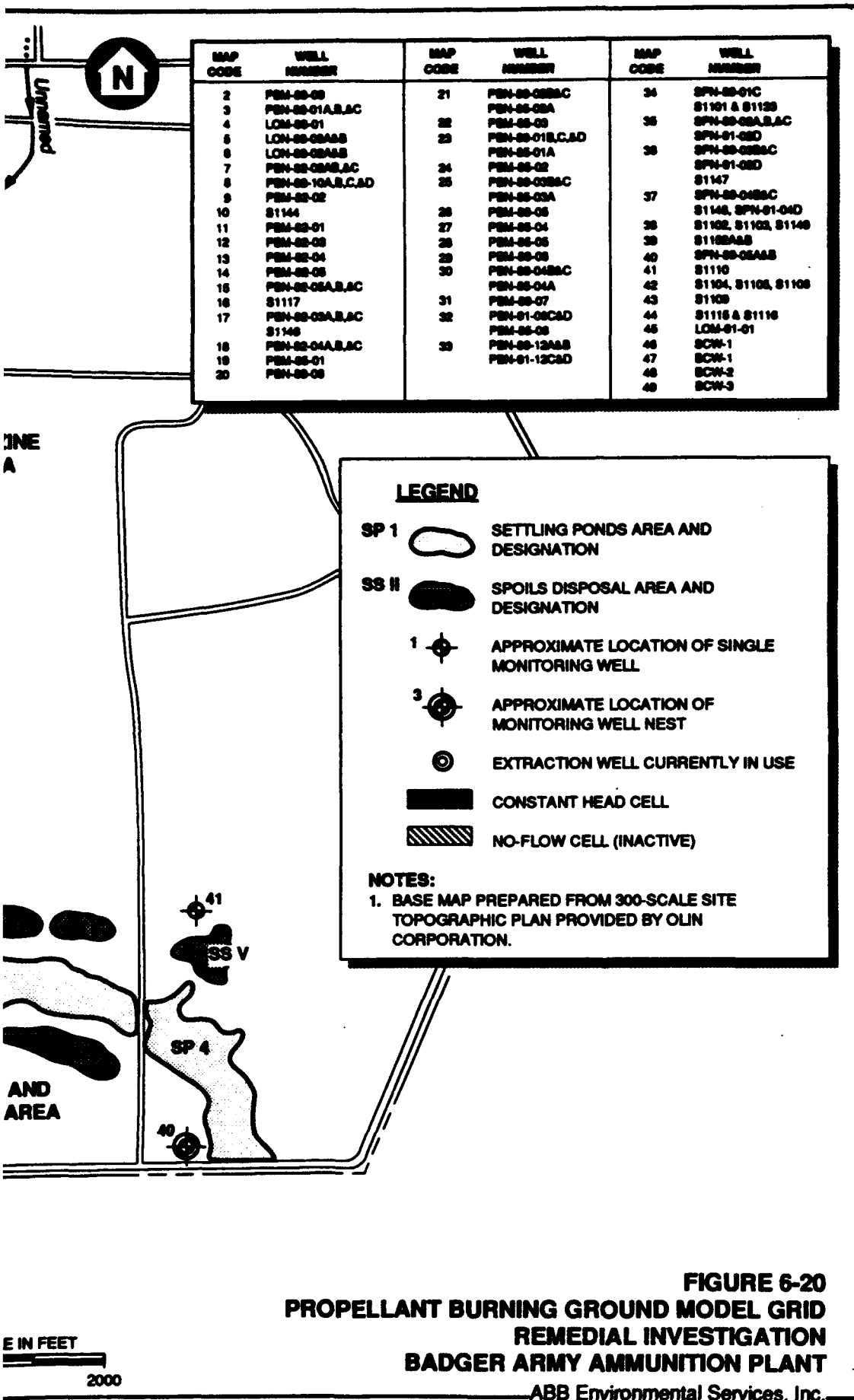




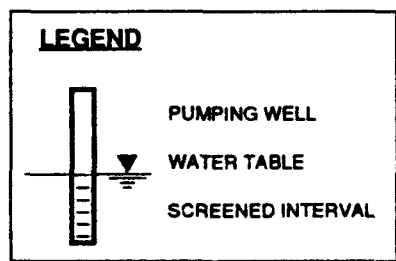
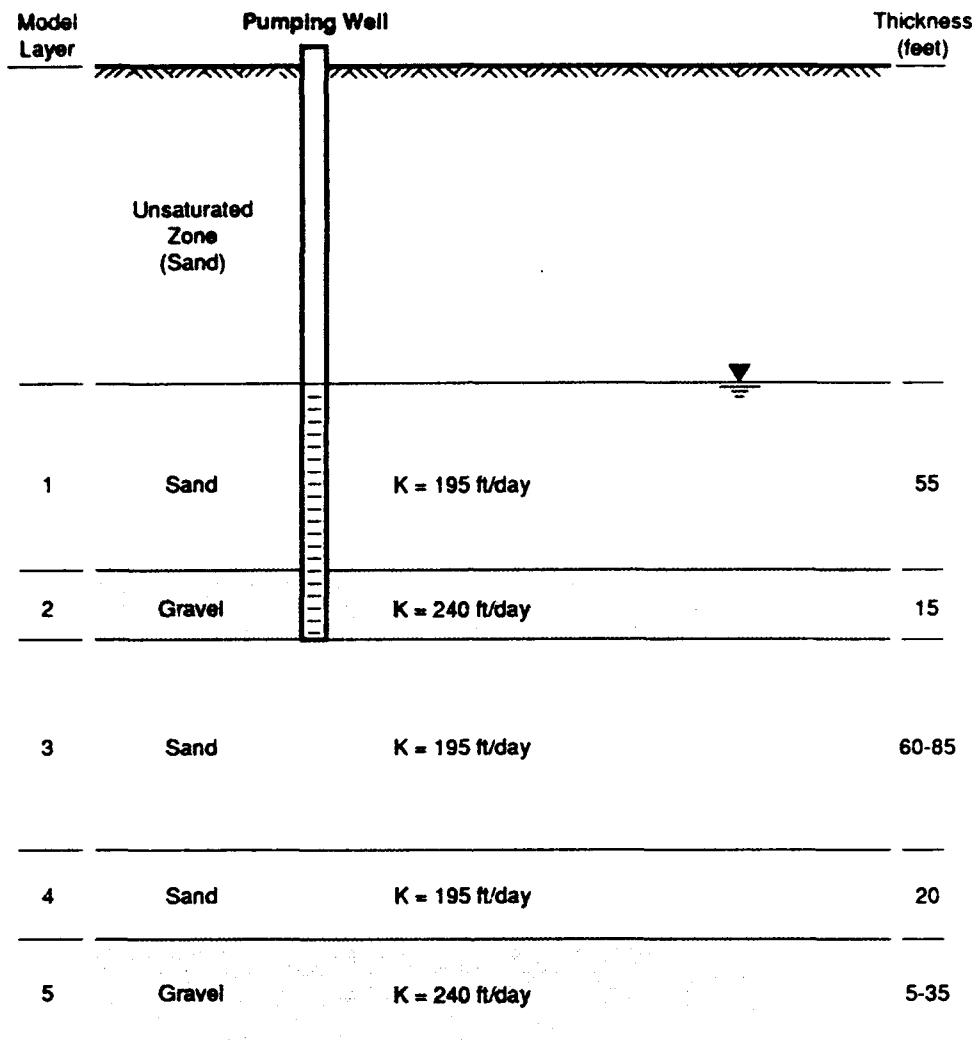












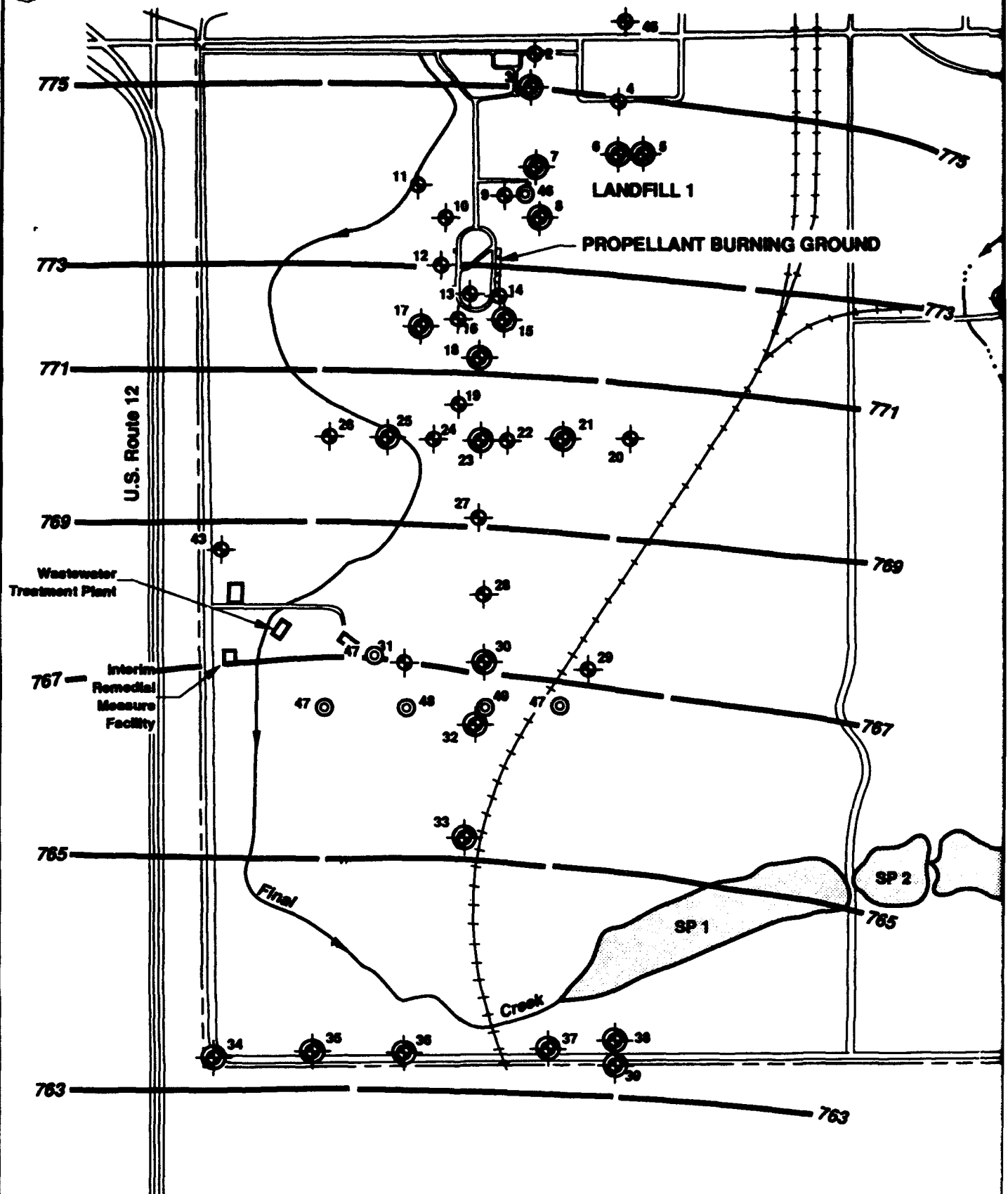
**NOT TO SCALE**

**FIGURE 6-21**  
**PROPELLANT BURNING GROUND**  
**MODEL LAYERS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

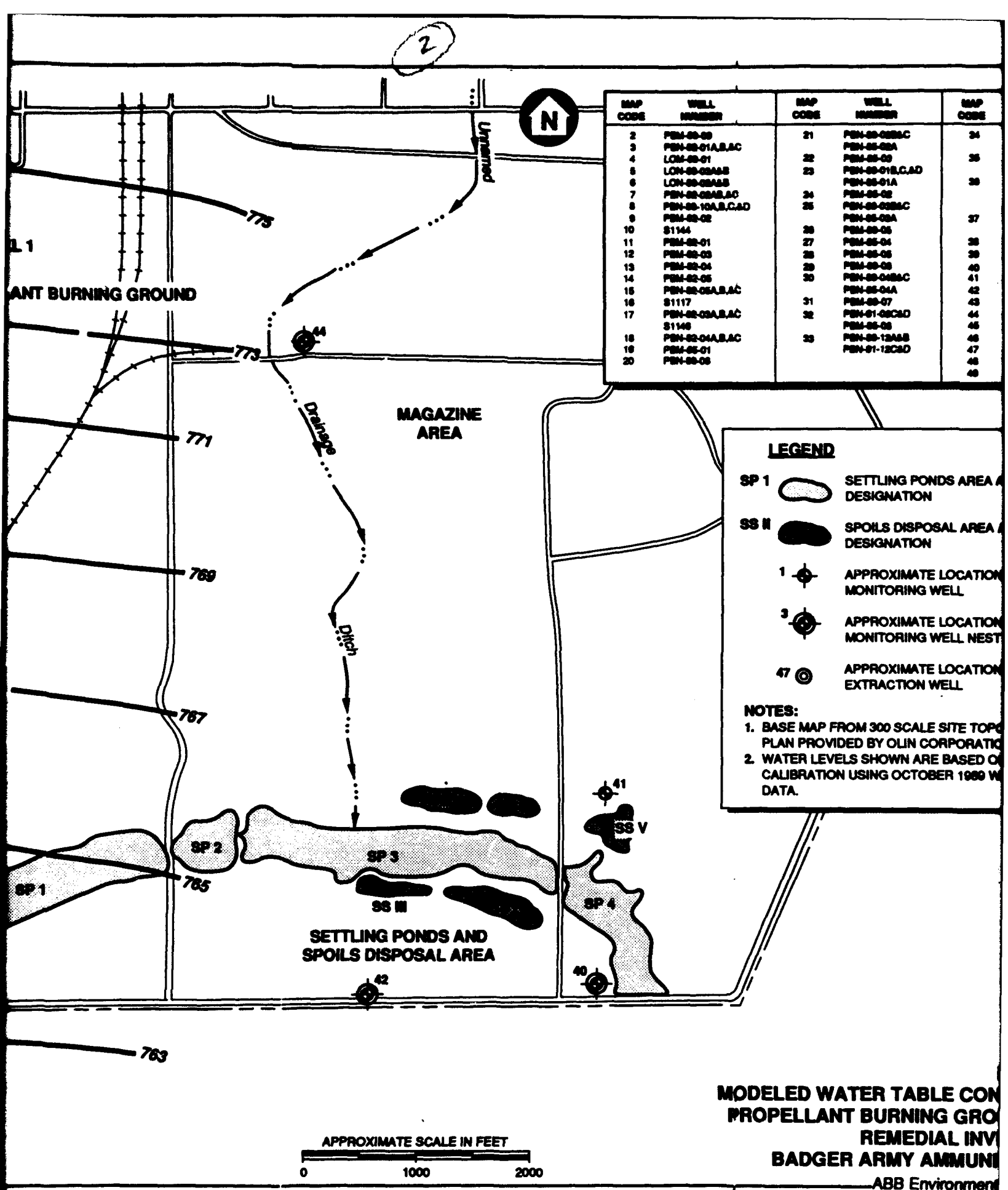
ABB Environmental Services, Inc.



1









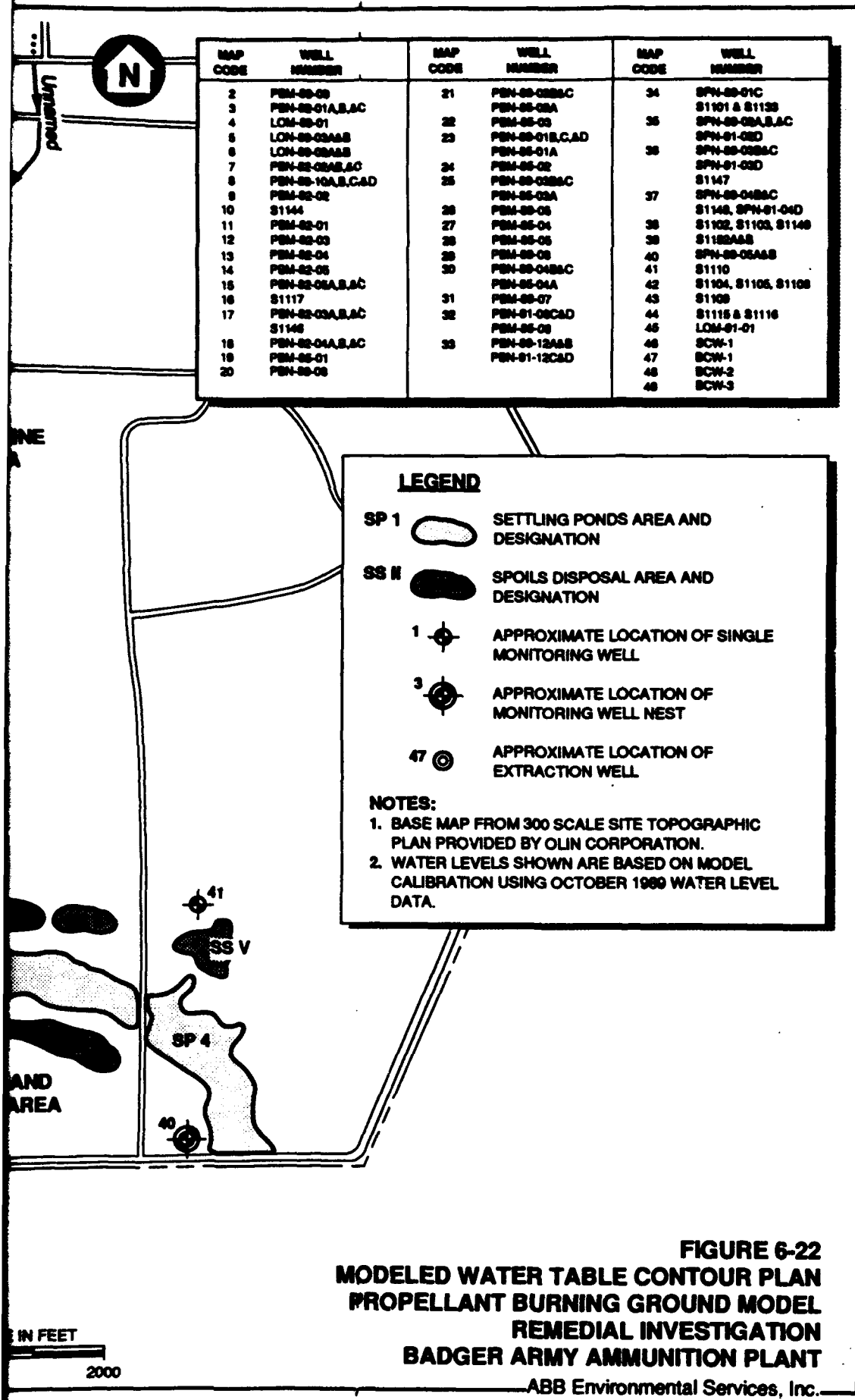
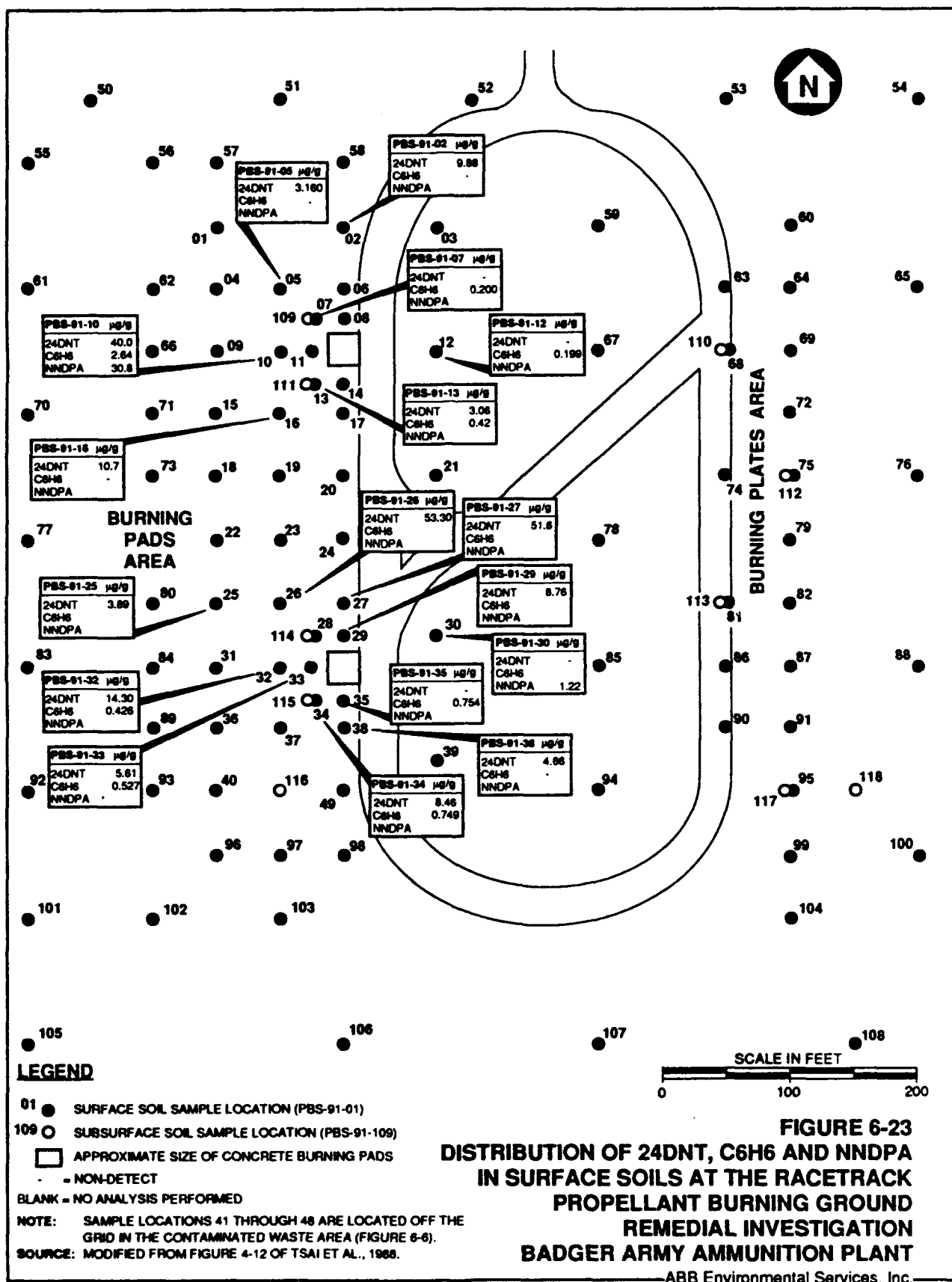


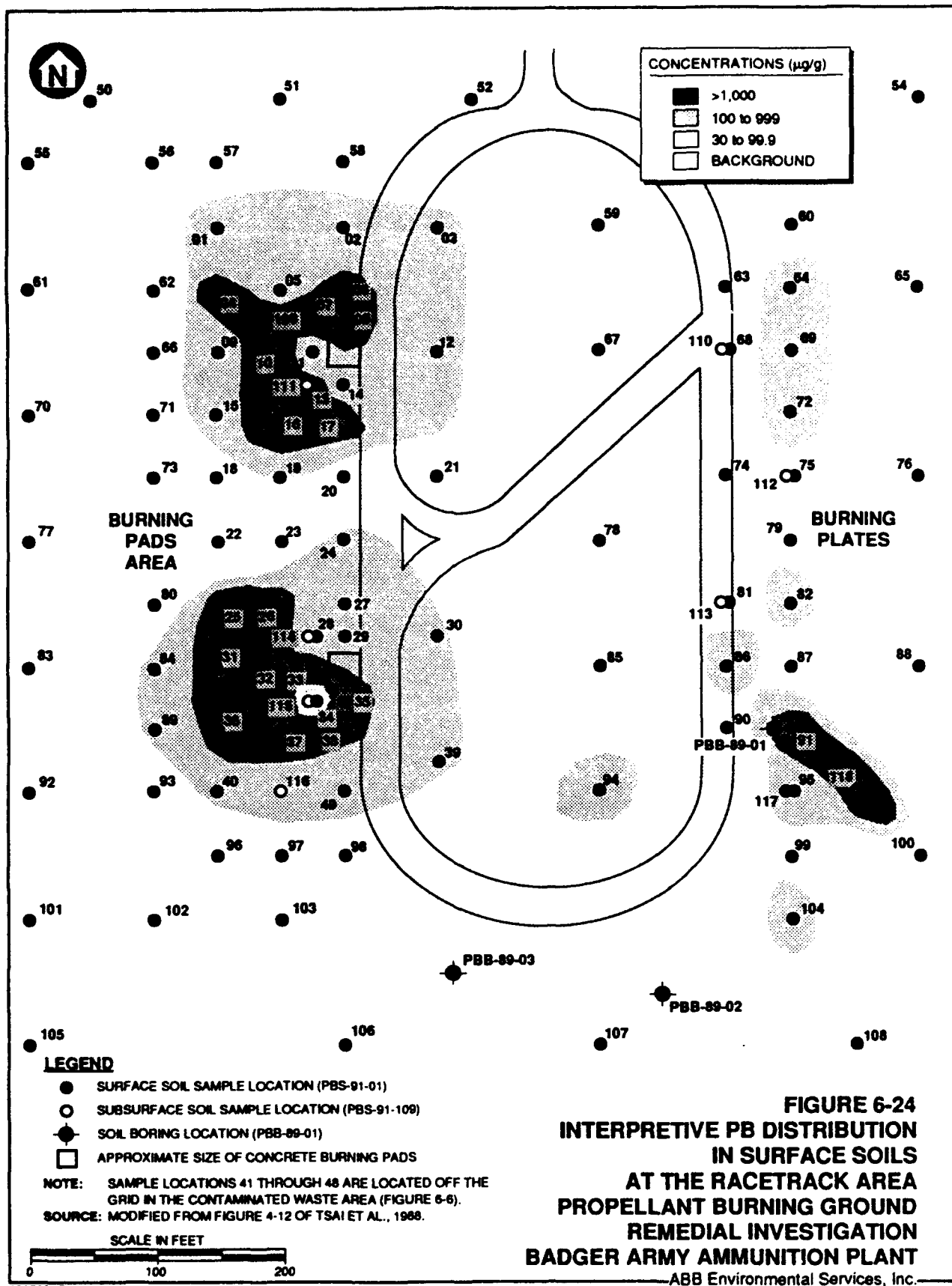
FIGURE 6-22  
MODELED WATER TABLE CONTOUR PLAN  
PROPELLANT BURNING GROUND MODEL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

ABB Environmental Services, Inc.

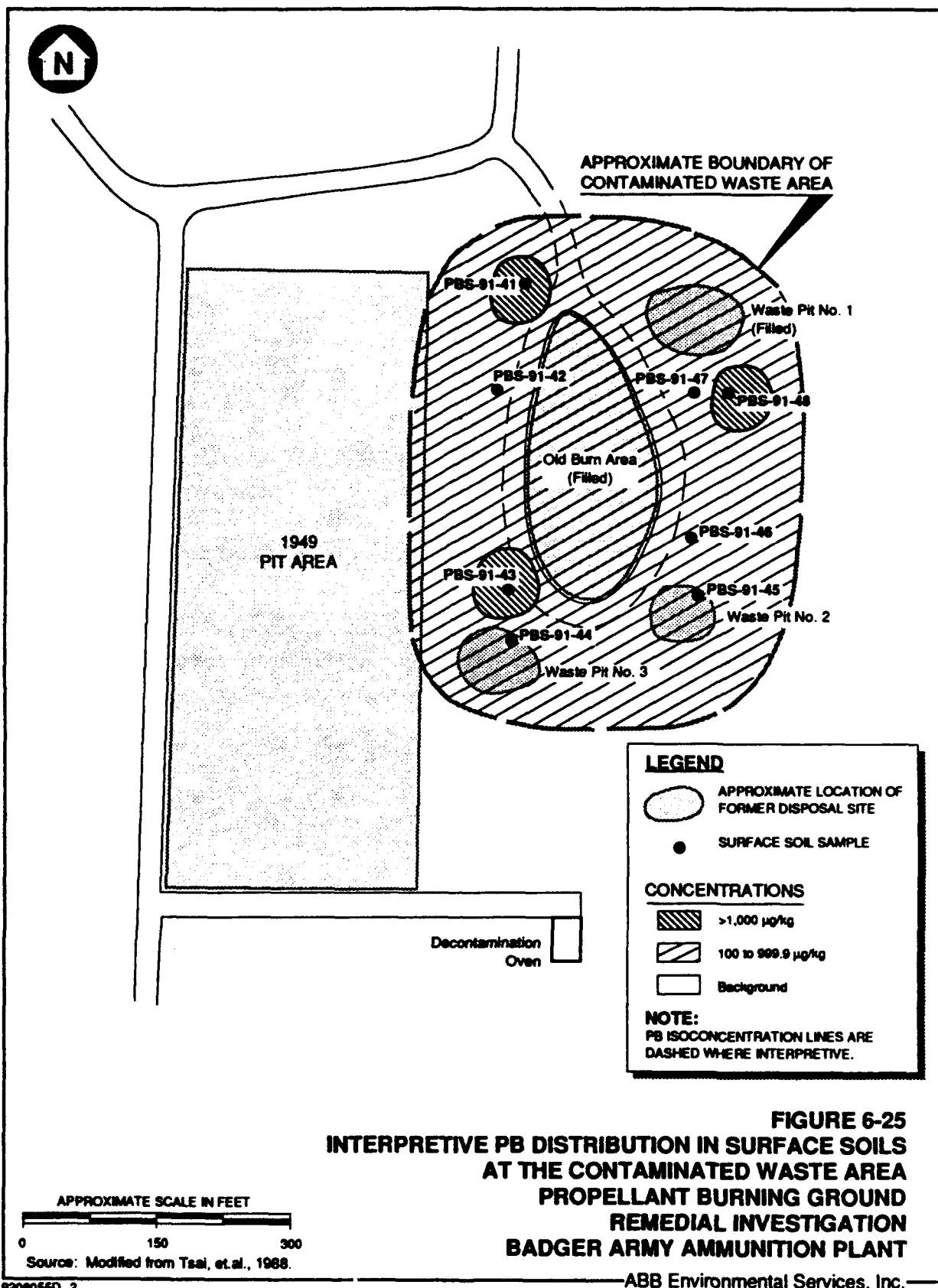




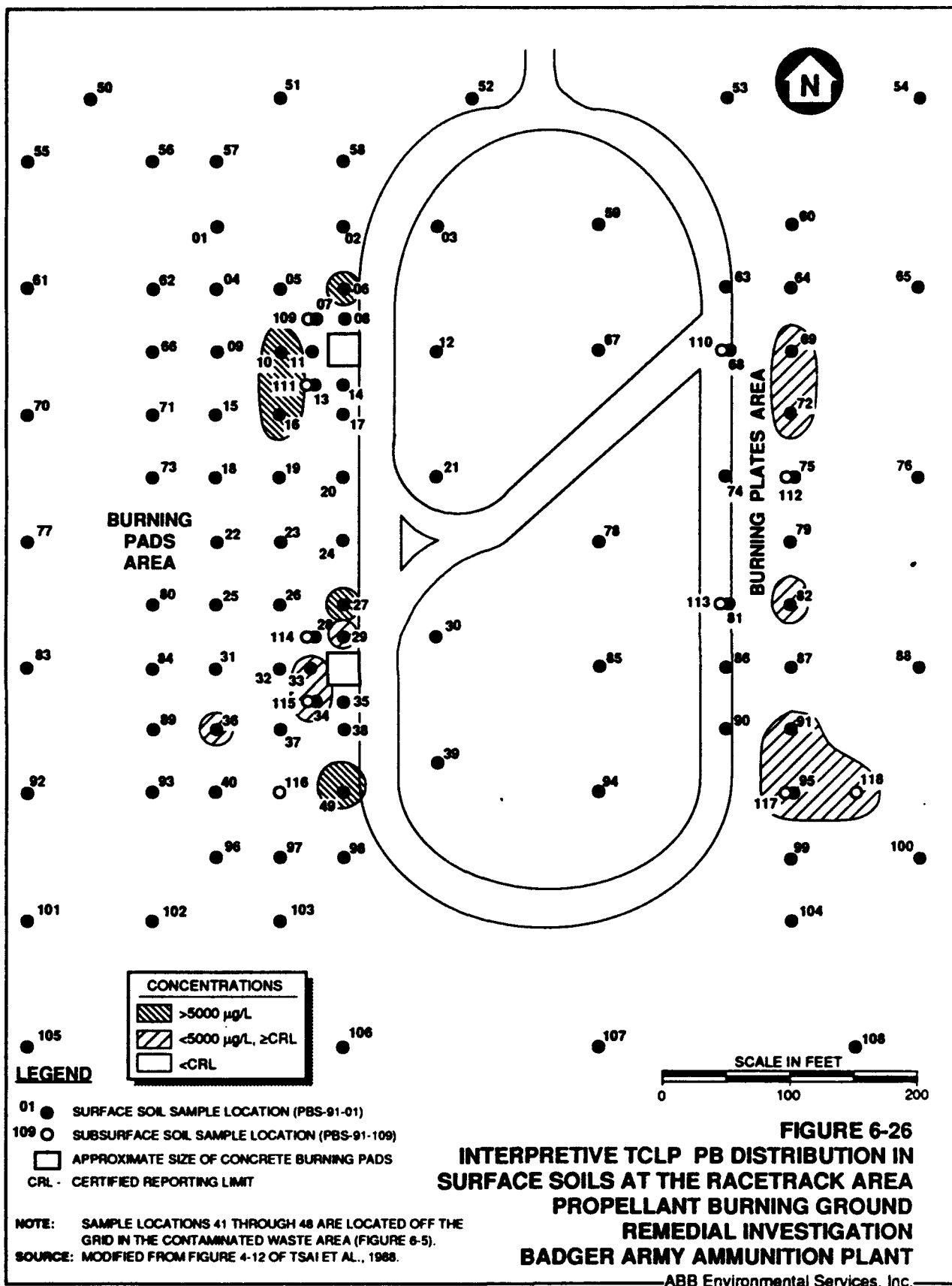




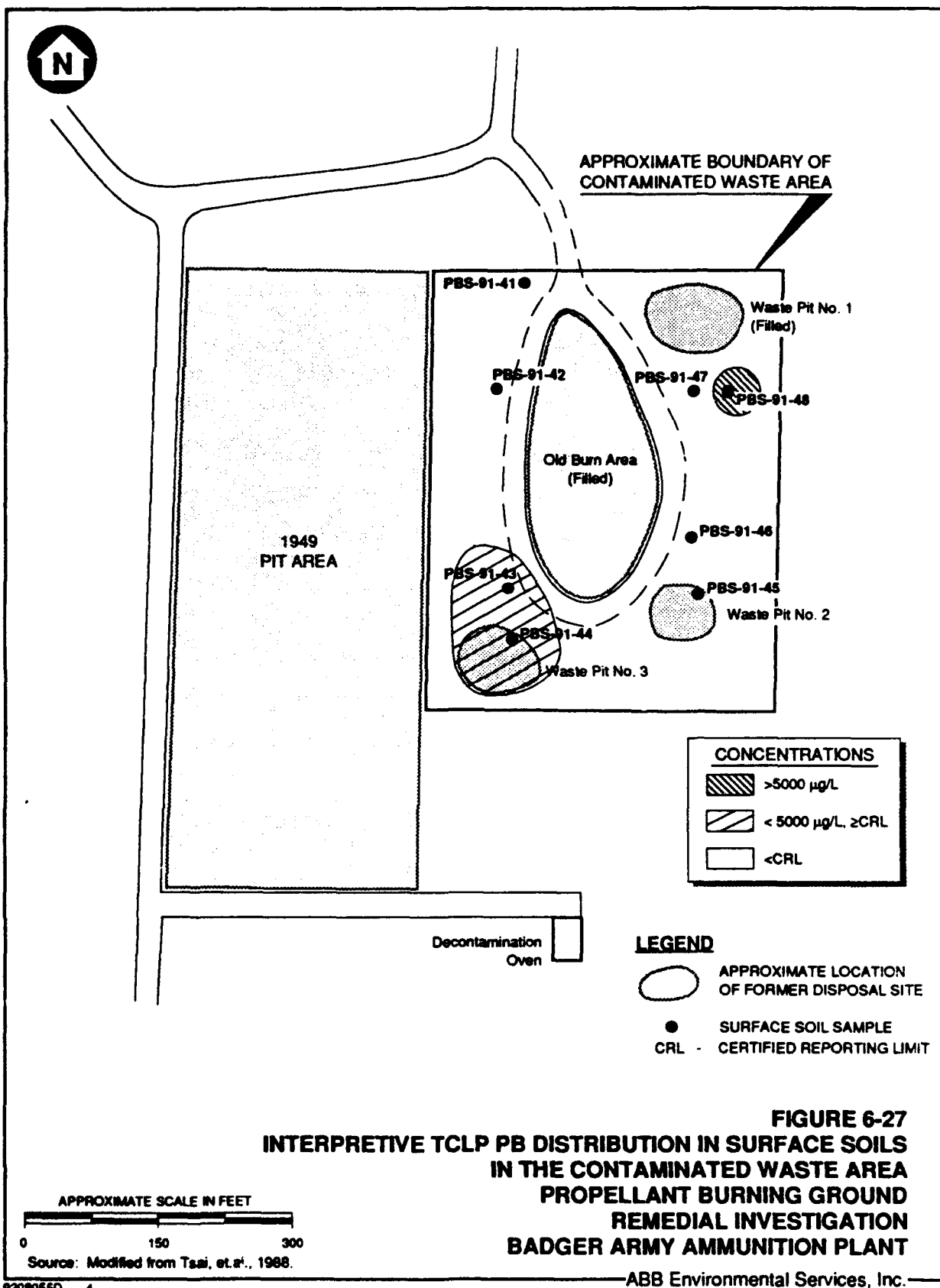




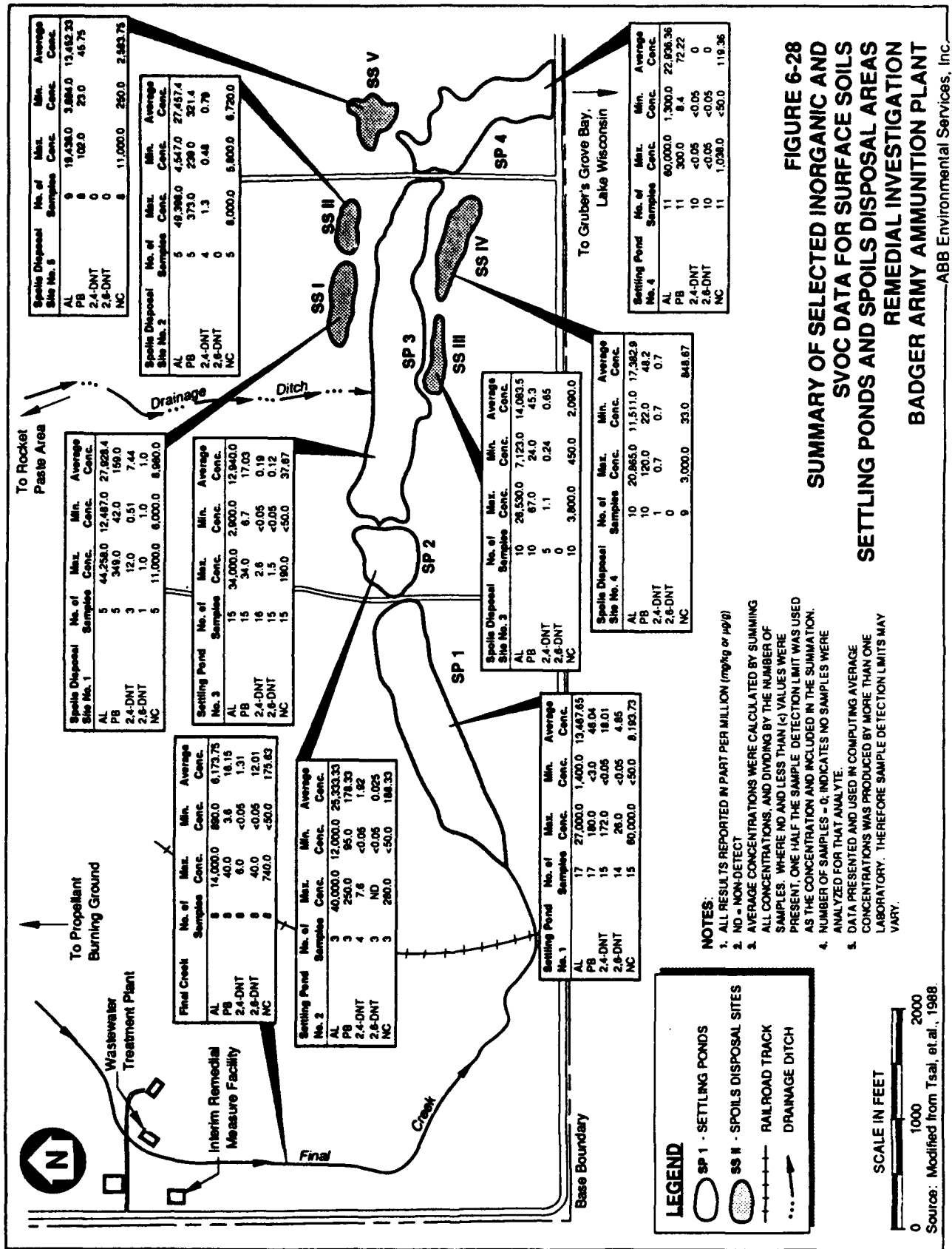




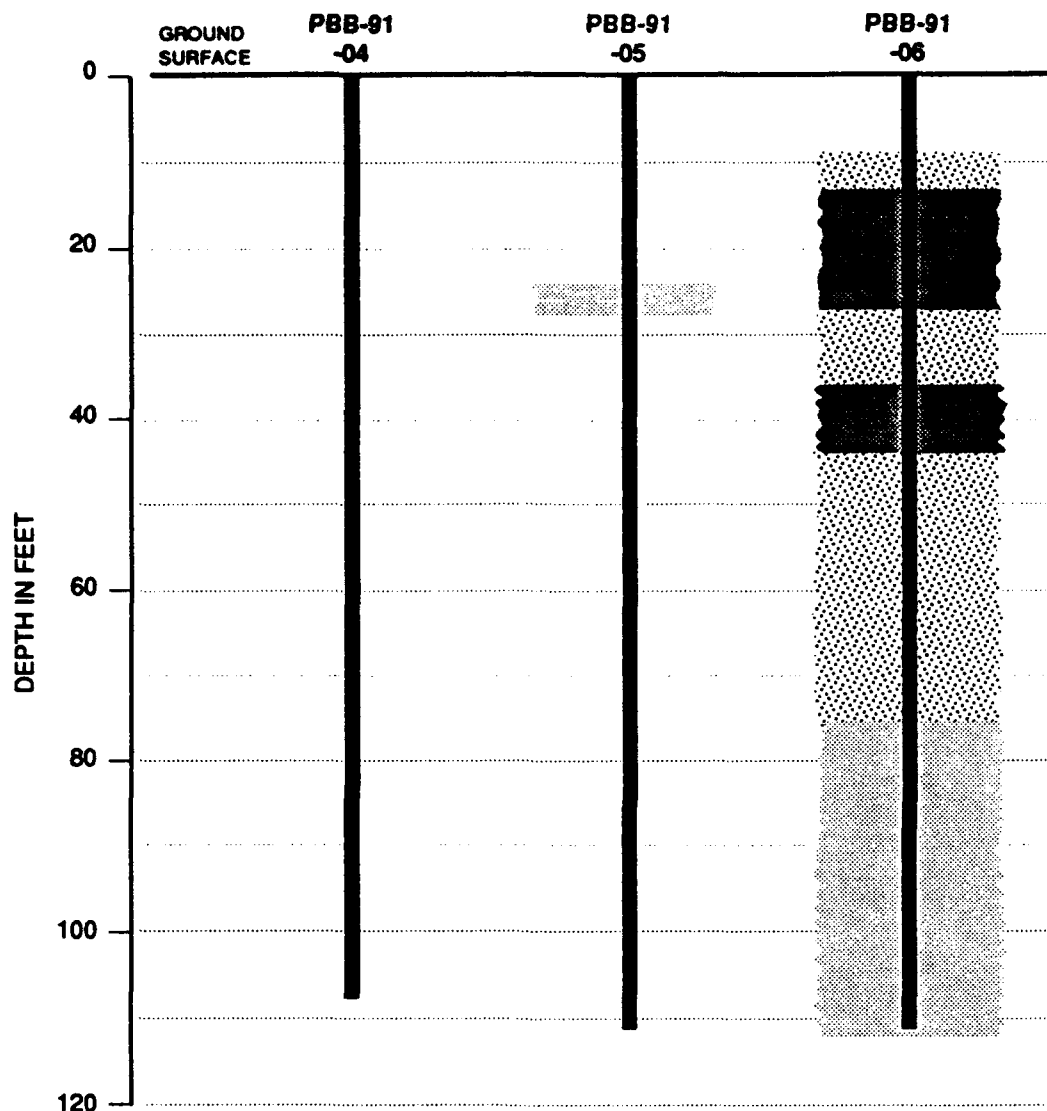















#### C6H6 CONCENTRATION

	> 100 ppm
	1.0 to 100 ppm
	ND to 1.0 ppm

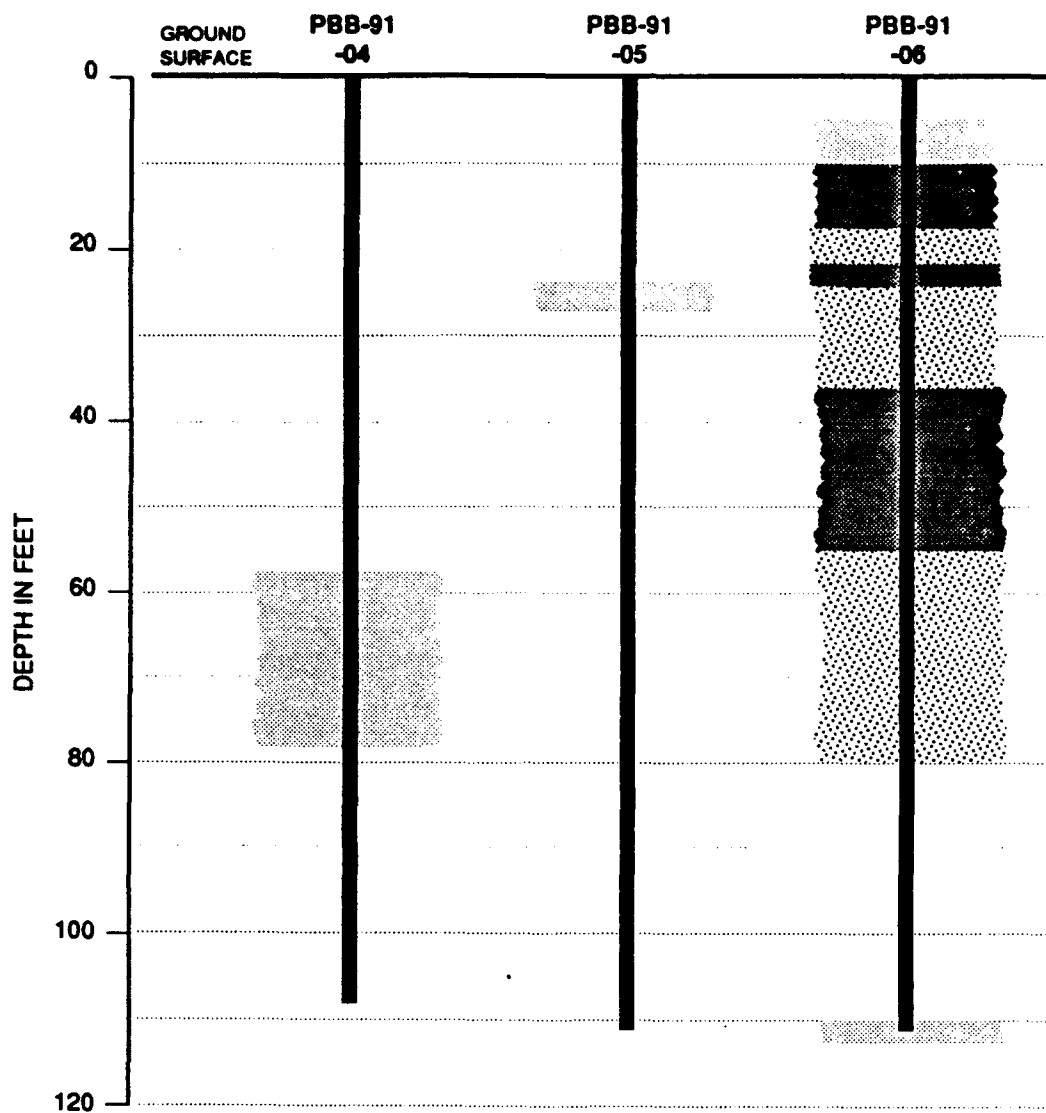
#### NOTE:

1. SEE TABLE 6-16 AND APPENDIX K FOR CHEMICAL DATA SUMMARY.




**FIGURE 6-29**  
**INTERPRETIVE C6H6 CONCENTRATIONS IN**  
**SUBSURFACE SOILS**  
**PROPELLANT BURNING GROUND WASTE PITS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





#### TRCLE CONCENTRATION

	> 10 ppm
	1.0 to 10 ppm
	ND to 1.0 ppm

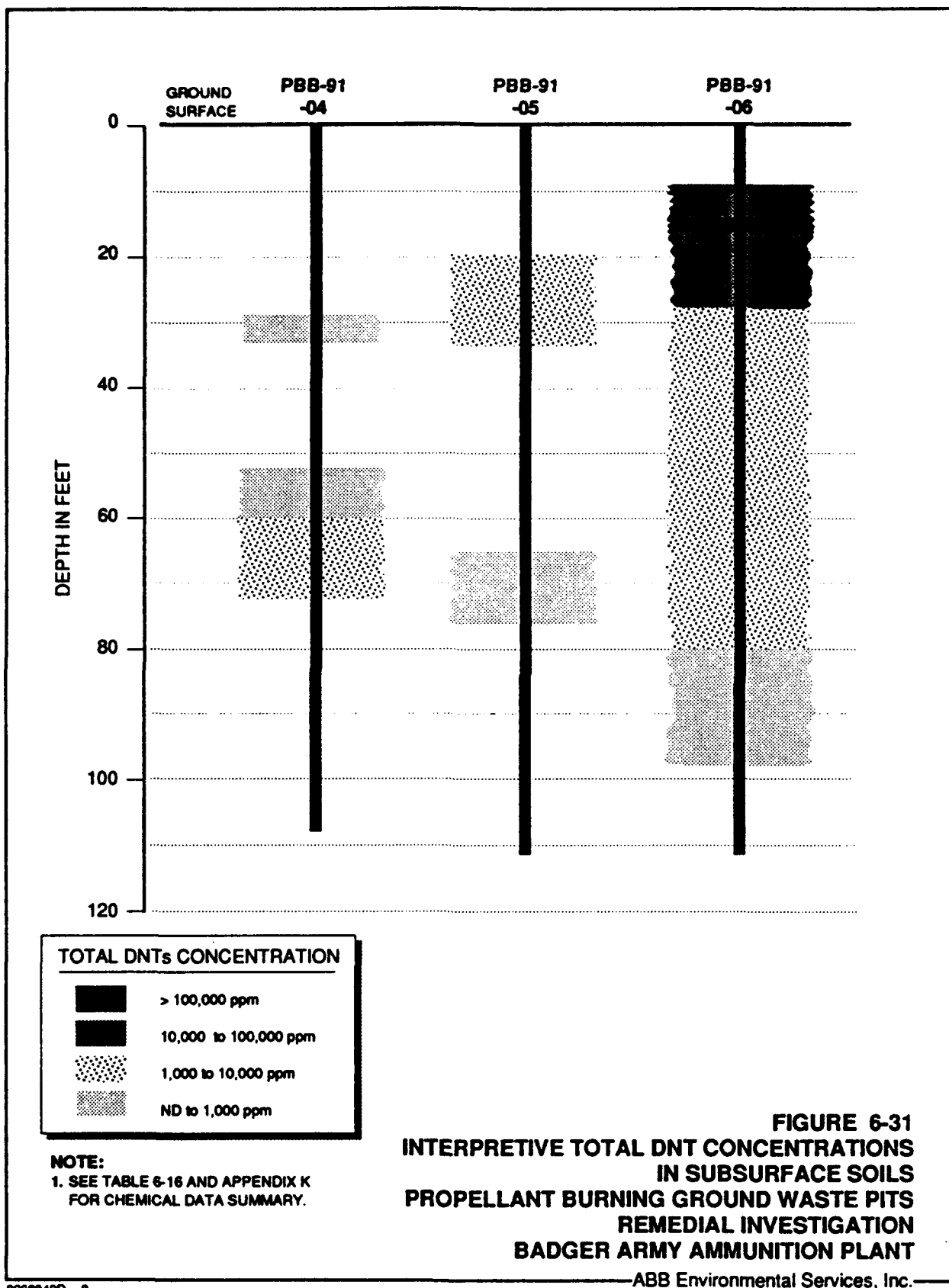
#### NOTE:

1. SEE TABLE 6-16 AND APPENDIX K FOR CHEMICAL DATA SUMMARY.

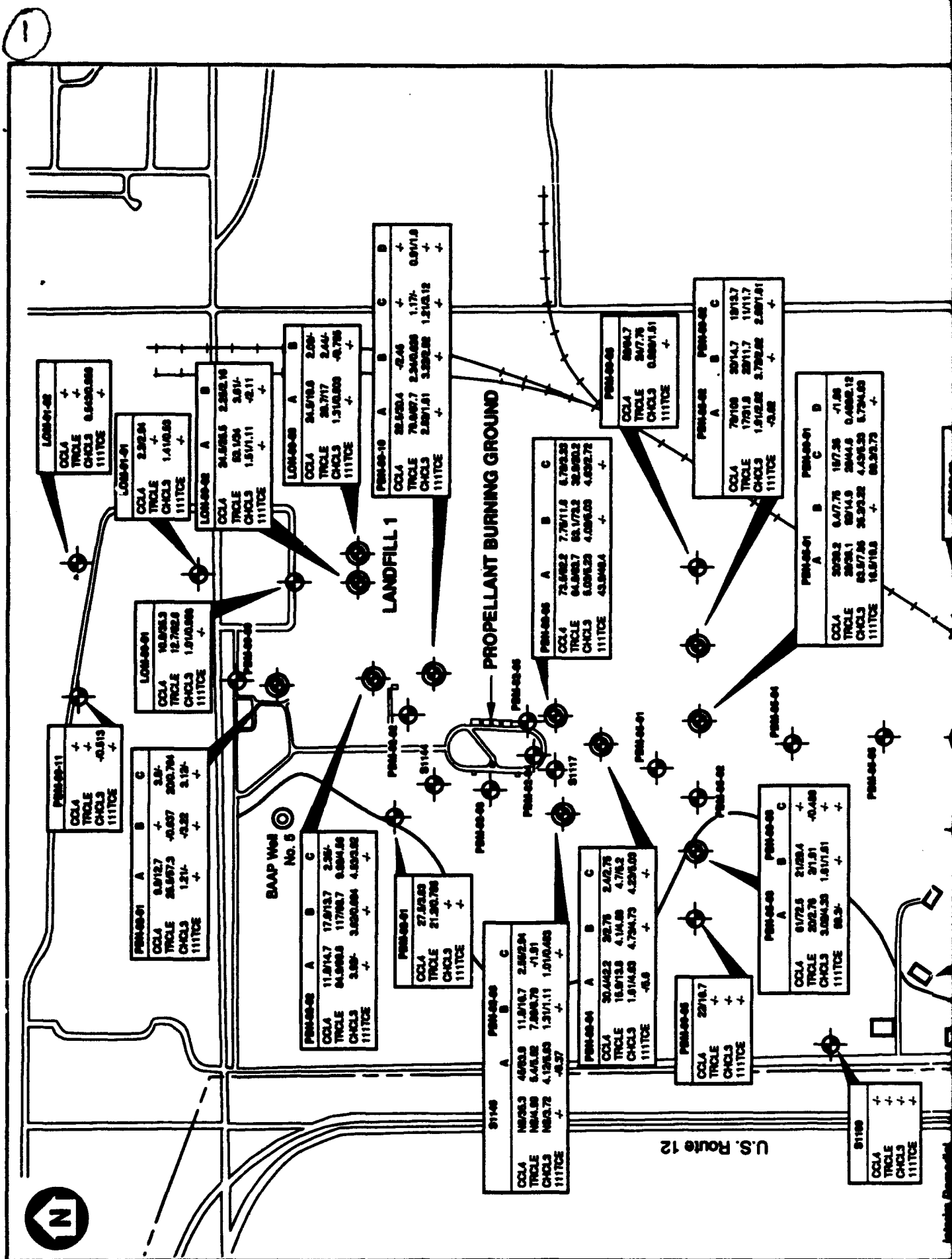
**FIGURE 6-30**  
**INTERPRETIVE TRCLE CONCENTRATIONS IN**  
**SUBSURFACE SOILS**  
**PROPELLANT BURNING GROUND WASTE PITS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

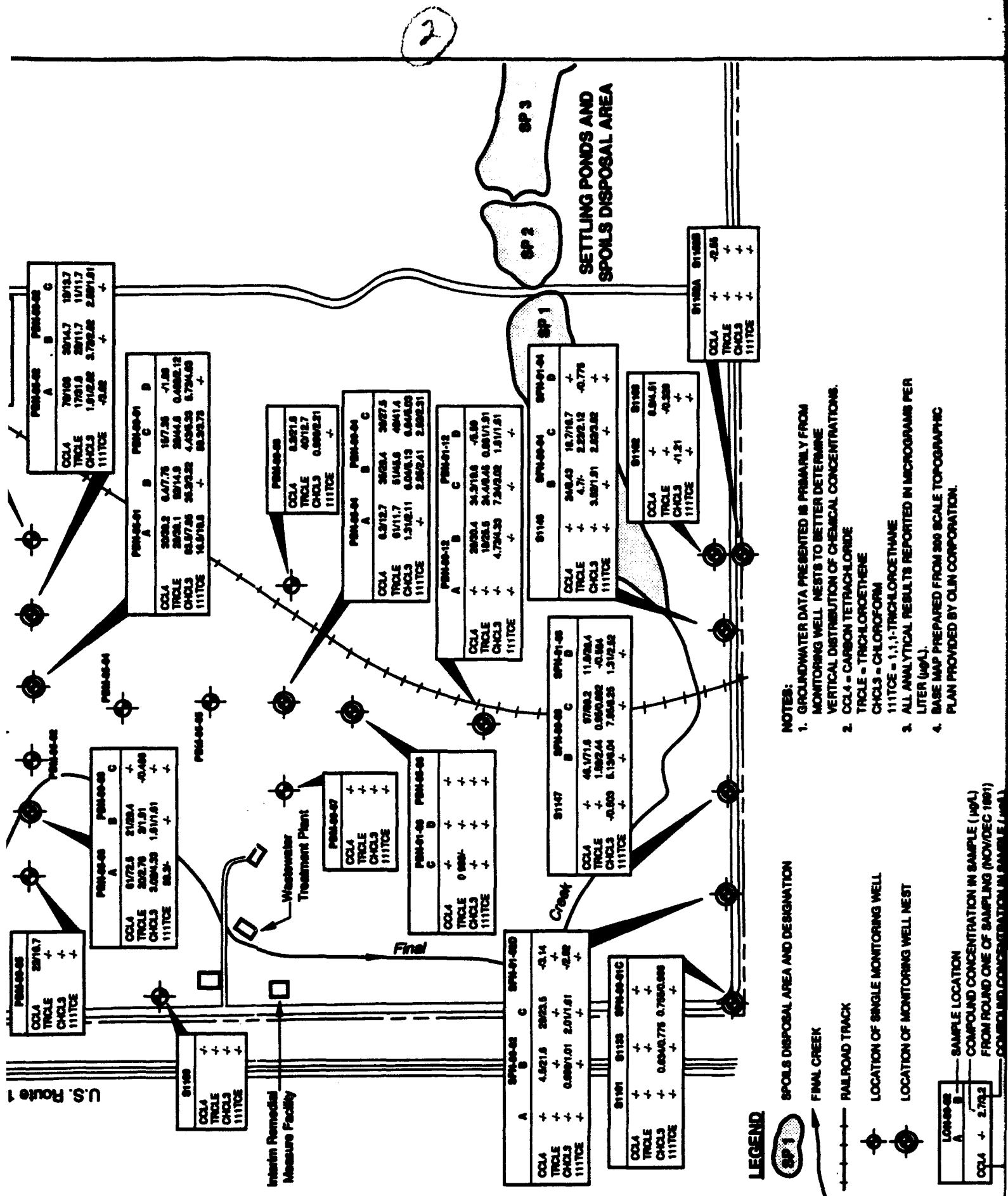




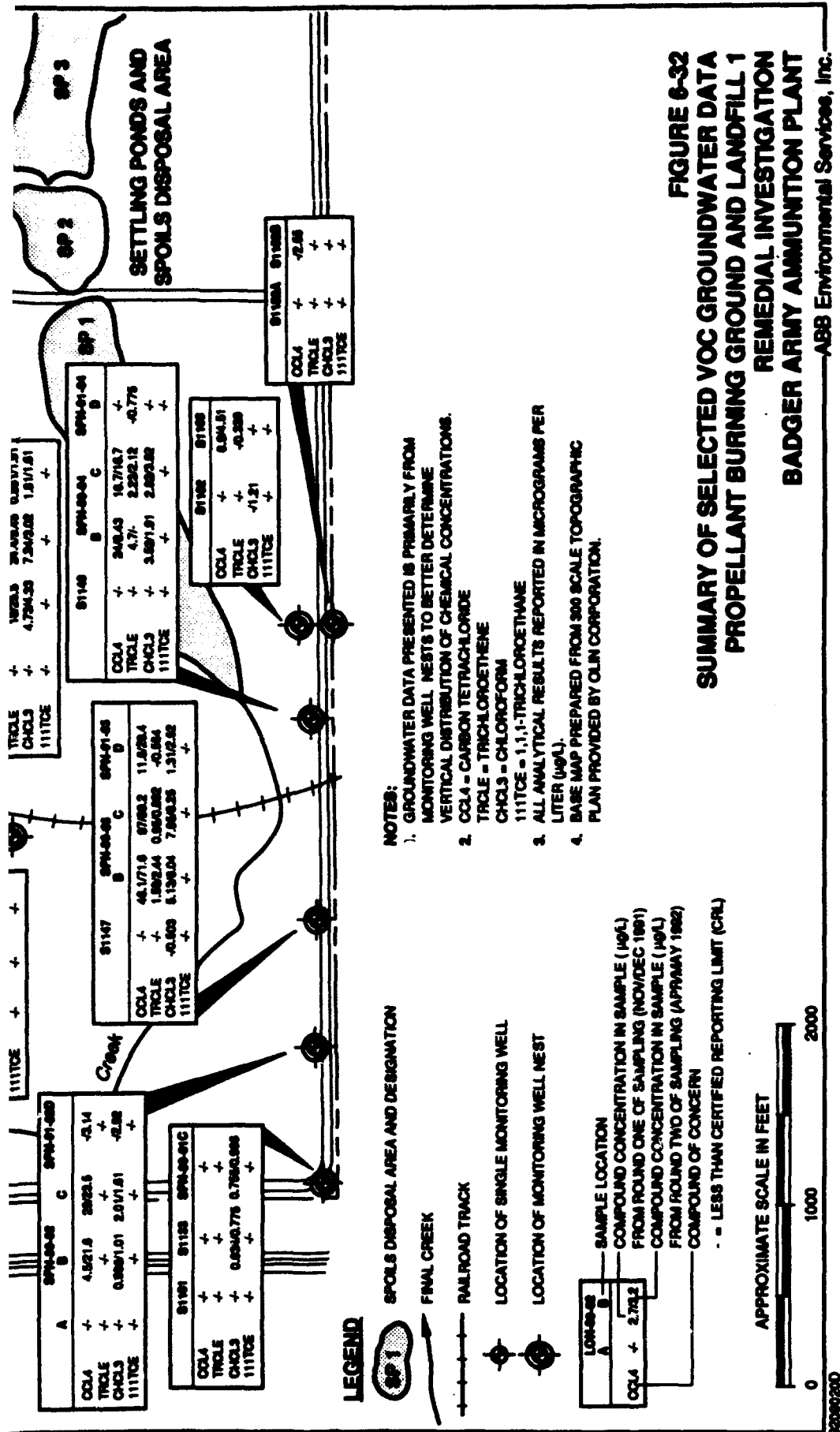




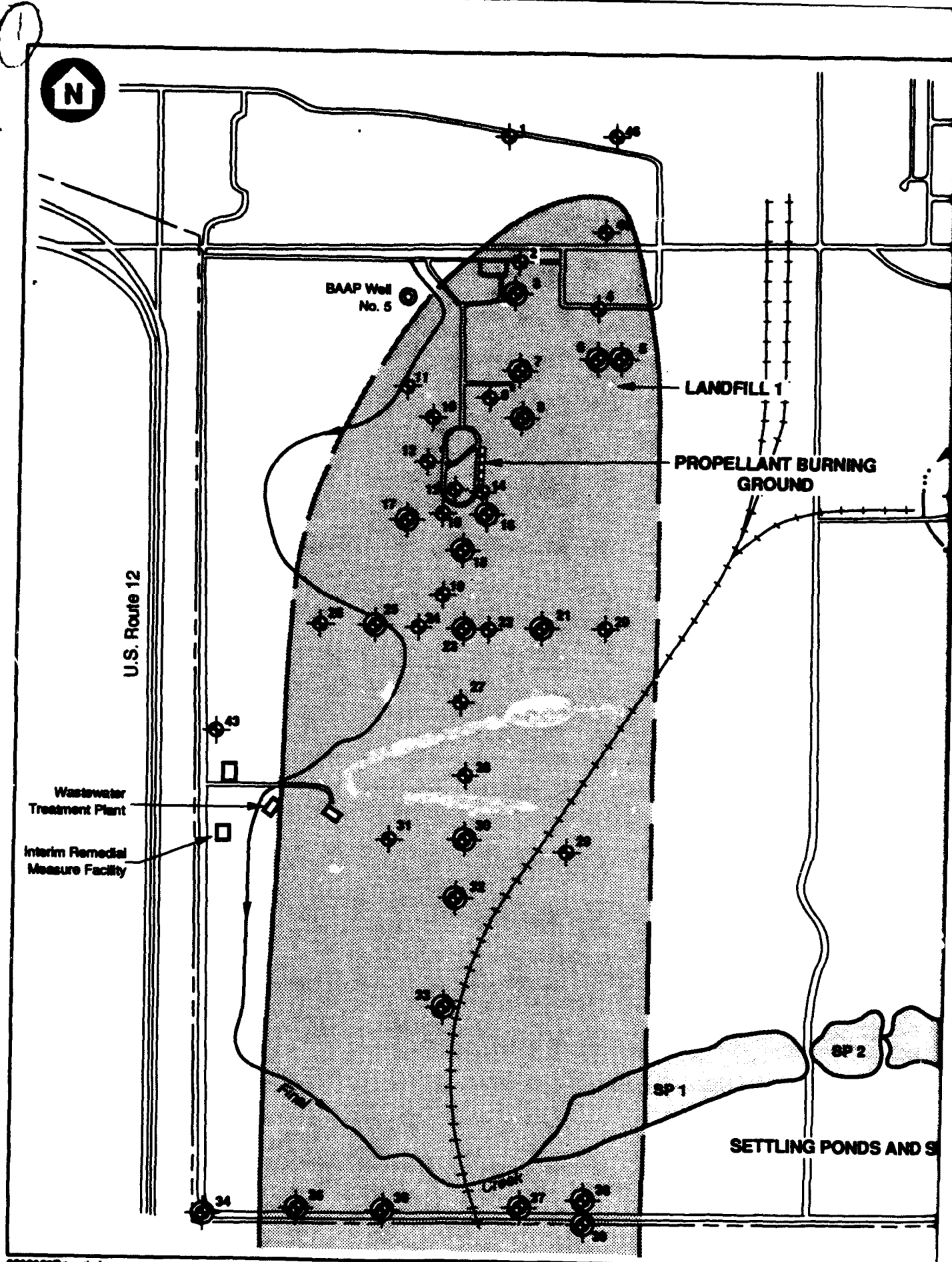














2

WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE
1	PEM-00-11	20	PEM-00-08	2
2	PEM-00-00	21	PEM-00-08BAC	3
3	PEM-00-01A,B,C		PEM-00-08A	4
4	LON-00-01	22	PEM-00-08	5
5	LON-00-03AAS	23	PEM-00-01B,C,D	6
6	LON-00-03AAS		PEM-00-01A	7
7	PEM-00-05A,B,C	24	PEM-00-02	8
8	PEM-00-10A,B,C,D	25	PEM-00-08BAC	9
9	PEM-00-02		PEM-00-08A	10
10	S1144	26	PEM-00-05	11
11	PEM-00-01	27	PEM-00-04	12
12	PEM-00-03	28	PEM-00-05	13
13	PEM-00-04	29	PEM-00-08	14
14	PEM-00-05	30	PEM-00-08BAC	15
15	PEM-00-05A,B,C		PEM-00-04A	16
16	S1117	31	PEM-00-07	17
17	PEM-00-03A,B,C	32	PEM-01-08C&D	18
	S1146		PEM-00-08	19
18	PEM-00-04A,B,C	33	PEM-00-13AAS	
19	PEM-00-01		PEM-01-12C&D	

APPROXIMATE

0 10

LANDFILL 1

PROPELLANT BURNING  
GROUND

MAGAZINE  
AREA

**LEGEND**

SP 1  SETTLING PONDS AREA  
DESIGNATION

SS II  SPOILS DISPOSAL AREA  
DESIGNATION

1  LOCATION OF SINGLE MONITOR

3  LOCATION OF MONITOR

 ESTIMATED EXTENT OF  
CONTAMINATION DASHED WHERE APPROXIMATE

**NOTE:**

1. BASE MAP FROM 300 SCALE SITE TOP  
GRAPHIC PLAN PROVIDED BY OLIN CORPORATION

SP 1

SP 2

SP 3

SS III

SP 4

SS V

SETTLING PONDS AND SPOILS DISPOSAL AREA

42

40

41

IN  
PLAN VIEW OF  
PROPELLANT BURNING  
GROUND

SETTLING  
SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
SITE

ABB Environmental



MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PEM-89-11	30	PEM-89-08	34	SPN-89-01C
2	PEM-89-09	21	PEM-89-08BAC		S1101 & S1139
3	PEM-89-01A,B,C		PEM-89-08A	35	SPN-89-08A,B,C
4	LOM-89-01	22	PEM-89-09		SPN-91-08D
5	LOM-89-03AAS	23	PEM-89-01B,C,AD	36	SPN-89-08BAC
6	LOM-89-08AAS		PEM-89-01A		SPN-91-08D
7	PEM-89-08A,B,C	24	PEM-89-02		S1147
8	PEM-89-10A,B,C,AD	25	PEM-89-08BAC	37	SPN-89-04BAC
9	PEM-89-02		PEM-89-03A		S1148, SPN-91-04D
10	S1144	26	PEM-89-05	38	S1102, S1103, S1149
11	PEM-89-01	27	PEM-89-04	39	S118AAS
12	PEM-89-03	28	PEM-89-05	40	SPN-89-05AAS
13	PEM-89-04	29	PEM-89-08	41	S1110
14	PEM-89-05	30	PEM-89-04BAC	42	S1104, S1105, S1108
15	PEM-89-05A,B,C		PEM-89-04A	43	S1109
16	S1117	31	PEM-89-07	44	S1115, S1116
17	PEM-89-03A,B,C	32	PEM-91-08C&D	45	LOM-91-01
18	PEM-89-04A,B,C		PEM-89-08	46	LOM-91-02
19	PEM-89-01	33	PEM-89-12AAS		
			PEM-91-12C&D		

APPROXIMATE SCALE IN FEET

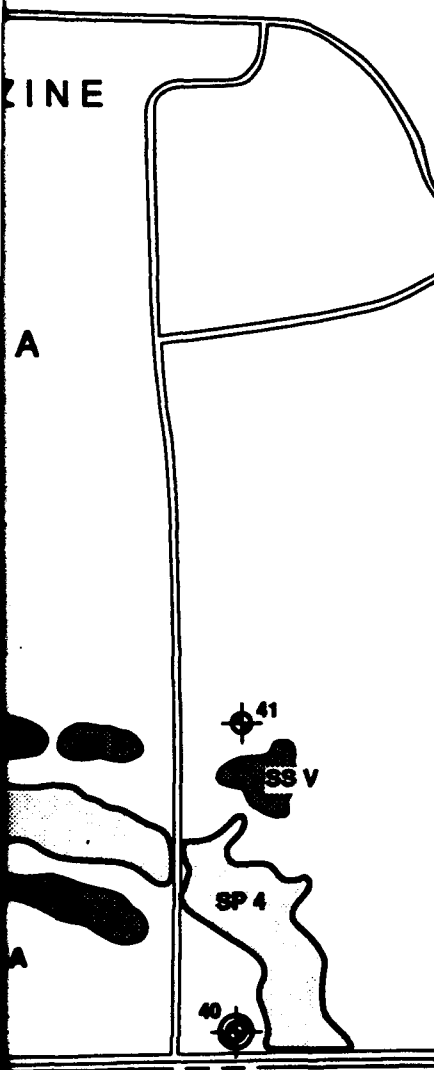


### LEGEND

- SP 1** **SETTLING PONDS AREA AND DESIGNATION**
- SS II** **SPOILS DISPOSAL AREA AND DESIGNATION**
- 1** **LOCATION OF SINGLE MONITORING WELL**
- 3** **LOCATION OF MONITORING WELL NEST**
- ESTIMATED EXTENT OF CCL4 PLUME, DASHED WHERE APPROXIMATED.**

### NOTE:

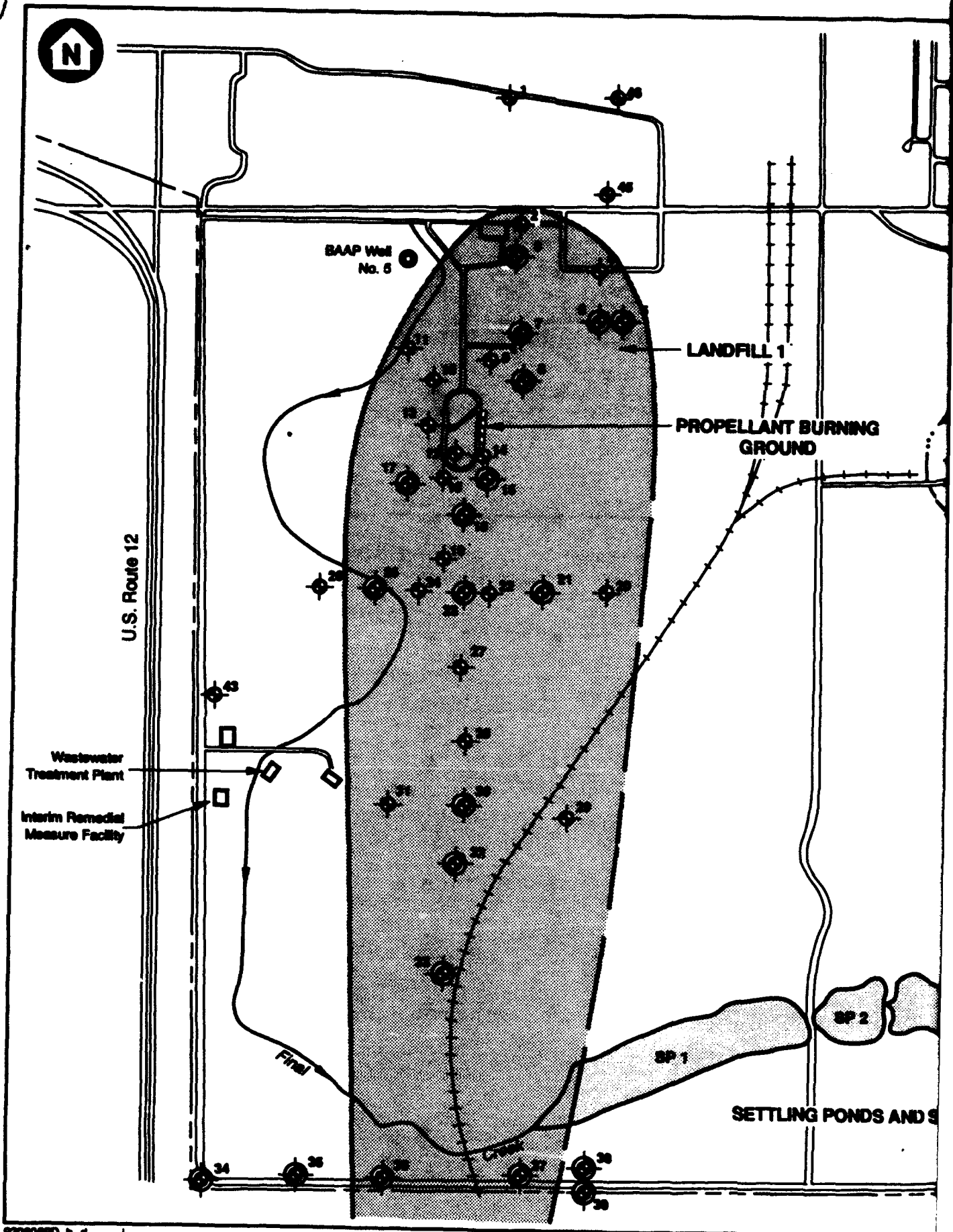
1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.



**FIGURE 6-33  
INTERPRETIVE  
PLAN VIEW OF CCL4 PLUME  
PROPELLANT BURNING GROUND,  
LANDFILL 1,  
SETTLING PONDS AND  
SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.







2

WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PEM-00-11	20	PEM-00-00
2	PEM-00-00	21	PEM-00-00BAC
3	PEM-00-01A,BAC		PEM-00-00A
4	LOM-00-01	22	PEM-00-00
5	LOM-00-00AAS	23	PEM-00-01B,C,AD
6	LOM-00-00AAS		PEM-00-01A
7	PEM-00-00BAC	24	PEM-00-00
8	PEM-00-10A,B,C,AD	25	PEM-00-00BAC
9	PEM-00-00		PEM-00-00A
10	S1144	26	PEM-00-00
11	PEM-00-01	27	PEM-00-04
12	PEM-00-00	28	PEM-00-00
13	PEM-00-04	29	PEM-00-00
14	PEM-00-00	30	PEM-00-01BAC
15	PEM-00-00A,BAC		PEM-00-01A
16	S1117	31	PEM-00-07
17	PEM-00-00A,BAC	32	PEM-01-00C,D
	S1140		PEM-00-00
18	PEM-00-01A,BAC	33	PEM-00-12AAS
19	PEM-00-01		PEM-01-12C,D

APPROXIMATE

0 10






LANDFILL 1

PROPELLANT BURNING  
GROUND

MAGAZINE

AREA

**LEGEND**

- SP 1  SETTLING PONDS AREA DESIGNATION
- SS II  SPOILS DISPOSAL AREA DESIGNATION
- 1  LOCATION OF SINGLE MONITOR
- 3  LOCATION OF MONITOR
-  ESTIMATED EXTENT OF DASHED WHERE APPROPRIATE

**NOTE:**  
1. BASE MAP FROM 300 SCALE SITE TOP  
PLAN PROVIDED BY OLIN CORPORATION

SP 1

SP 2

SP 3

SS III

SP 4

SS V

SETTLING PONDS AND SPOILS DISPOSAL AREA

42

40

41

IN  
PLAN VIEW OF THE  
PROPELLANT BURNING

SETTLING  
SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION

ABB Environmental



ROCKET  
AREA

GAZINE

REA

L AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PEN-00-11	20	PEN-00-00	34	SPN-00-01C
2	PEN-00-00	21	PEN-00-00BAC		S1101 & S1130
3	PEN-00-01A,B,C		PEN-00-00A	35	SPN-00-00A,B,C
4	LOM-00-01	22	PEN-00-00		SPN-01-00D
5	LOM-00-00A,B	23	PEN-00-01B,C,A,D	36	SPN-00-00BAC
6	LOM-00-00A,B		PEN-00-01A		SPN-01-00D
7	PEN-00-00A,B,C	24	PEN-00-02		S1147
8	PEN-00-10A,B,C,A,D	25	PEN-00-00BAC	37	SPN-00-00BAC
9	PEN-00-02		PEN-00-00A		S1140, SPN-01-00D
10	S1144	26	PEN-00-00	38	S1102, S1105, S1140
11	PEN-00-01	27	PEN-00-04	39	S1100A,B
12	PEN-00-00	28	PEN-00-00	40	SPN-00-00A,B
13	PEN-00-04	29	PEN-00-00	41	S1110
14	PEN-00-00	30	PEN-00-00BAC	42	S1104, S1105, S1108
15	PEN-00-00A,B,C		PEN-00-04A	43	S1100
16	S1117	31	PEN-00-07	44	S1115, S1116
17	PEN-00-00A,B,C	32	PEN-01-00C&D	45	LOM-01-01
	S1140		PEN-00-00	46	LOM-01-02
18	PEN-00-04A,B,C	33	PEN-00-10A,B		
19	PEN-00-01		PEN-01-10C&D		

APPROXIMATE SCALE IN FEET



### LEGEND

- SP 1 SETTLING PONDS AREA AND DESIGNATION
- SS II SPOILS DISPOSAL AREA AND DESIGNATION
- 1 LOCATION OF SINGLE MONITORING WELL
- 3 LOCATION OF MONITORING WELL NEST
- ESTIMATED EXTENT OF TRCLE PLUME, DASHED WHERE APPROXIMATED.

### NOTE:

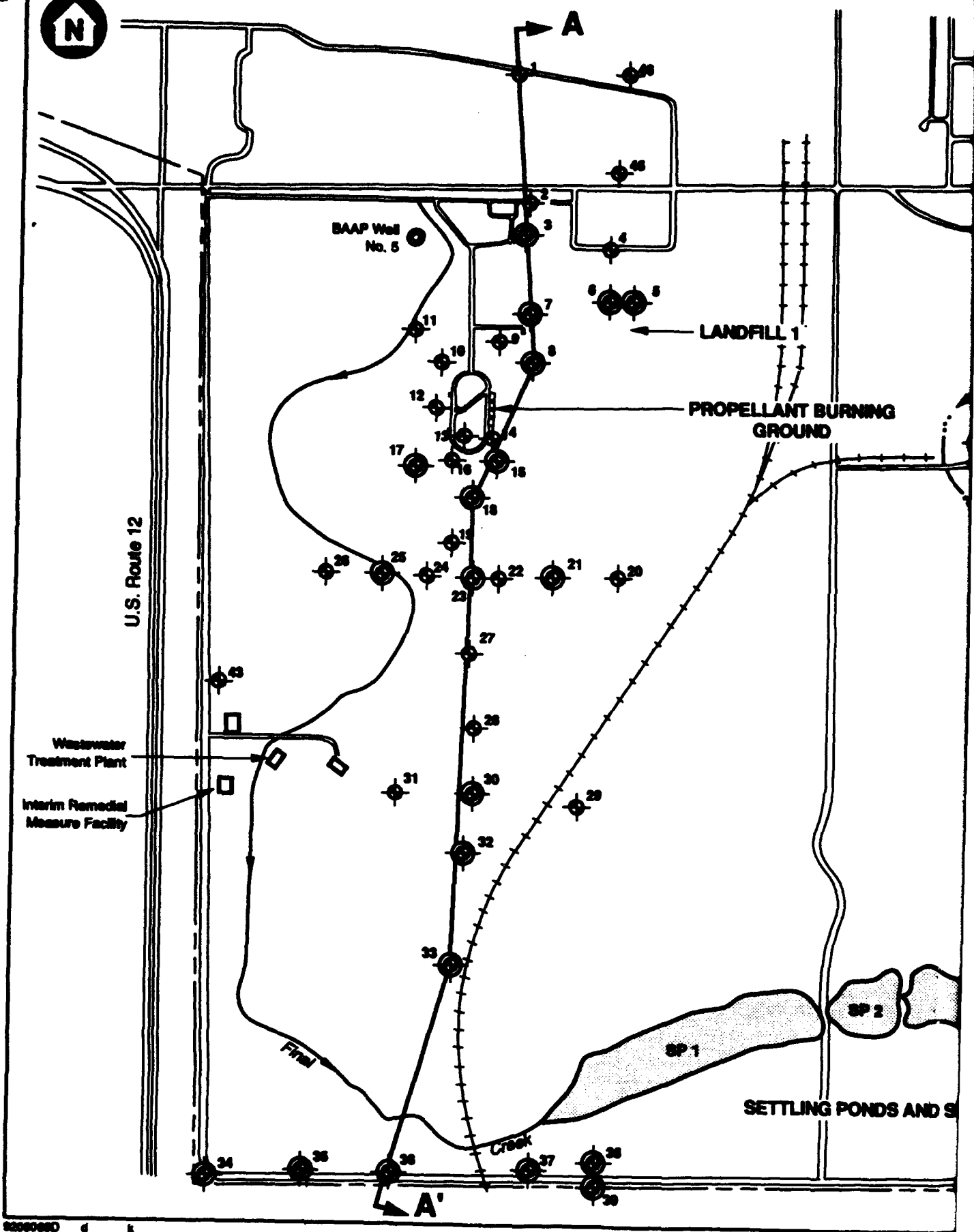
1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.

**FIGURE 6-34  
INTERPRETIVE  
PLAN VIEW OF TRCLE PLUME  
PROPELLANT BURNING GROUND,  
LANDFILL 1,  
SETTLING PONDS AND  
SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

—ABB Environmental Services, Inc.—



1





2  
WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE
1	PEN-05-11	20	PEN-05-05	2
2	PEN-05-03	21	PEN-05-05BAC	3
3	PEN-05-01A,B,C		PEN-05-05A	4
4	LON-05-01	22	PEN-05-05	5
5	LON-05-05A,B	23	PEN-05-01B,C,D	6
6	LON-05-05A,B		PEN-05-01A	7
7	PEN-05-05A,B,C	24	PEN-05-02	8
8	PEN-05-10A,B,C,D	25	PEN-05-05BAC	9
9	PEN-05-02		PEN-05-05A	10
10	S1144	26	PEN-05-05	11
11	PEN-05-01	27	PEN-05-04	12
12	PEN-05-03	28	PEN-05-05	13
13	PEN-05-04	29	PEN-05-05	14
14	PEN-05-05	30	PEN-05-04BAC	15
15	PEN-05-05A,B,C		PEN-05-04A	16
16	S1117	31	PEN-05-07	17
17	PEN-05-05A,B,C	32	PEN-01-05C&D	18
18	S1148		PEN-05-05	19
19	PEN-05-04A,B,C	33	PEN-05-10A,B	
	PEN-05-01		PEN-01-12C&D	

APPROXIMATE

0 10

LANDFILL 1

PROPELLANT BURNING  
GROUND

MAGAZINE

AREA

Ditch

Ditch

SP 1

SP 2

SP 3

SS III

41

SS V

SP 4

SETTLING PONDS AND SPOILS DISPOSAL AREA

42

40

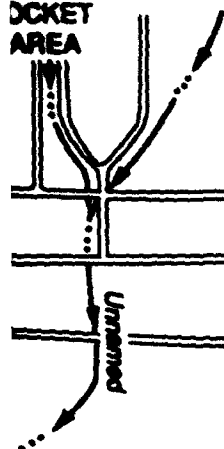
ORIENTATION OF CO  
PLUME CROSS S  
PROPELLANT BURNIN

SETTLING  
SPOILS DISF  
REMEDIAL INV  
BADGER ARMY AMMUN

ABB Environment



DOCKET  
AREA



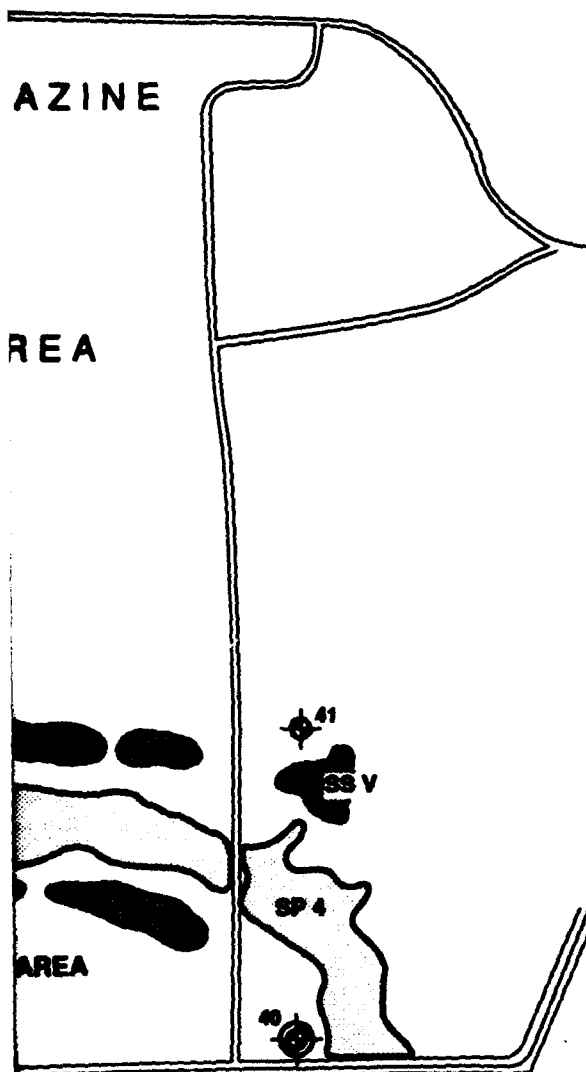
MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PEN-00-11	20	PEN-00-08	34	SPN-00-01C
2	PEN-00-09	21	PEN-00-08BAC		S1101 & S1102
3	PEN-00-01A,B,C		PEN-00-08A	35	SPN-00-02A,B,C
4	LOM-00-01	22	PEN-00-09		SPN-01-02D
5	LOM-00-02A,B	23	PEN-00-01B,C,D	36	SPN-00-02BAC
6	LOM-00-02A,B		PEN-00-01A		SPN-01-02D
7	PEN-00-02A,B,C	24	PEN-00-02		S1147
8	PEN-00-10A,B,C,D	25	PEN-00-02BAC	37	SPN-00-04BAC
9	PEN-00-02		PEN-00-02A		S1148, SPN-01-04D
10	S1144	26	PEN-00-05	38	S1102, S1105, S1149
11	PEN-00-01	27	PEN-00-04	39	S1105A,B
12	PEN-00-03	28	PEN-00-05	40	SPN-00-05A,B
13	PEN-00-04	29	PEN-00-06	41	S1110
14	PEN-00-05	30	PEN-00-04BAC	42	S1104, S1105, S1106
15	PEN-00-05A,B,C		PEN-00-04A	43	S1103
16	S1117	31	PEN-00-07	44	S1112, S1116
17	PEN-00-02A,B,C	32	PEN-01-05C&D	45	LOM-01-01
	S1149		PEN-00-08	46	LOM-01-02
18	PEN-00-04A,B,C	33	PEN-00-12A,B		
19	PEN-00-01		PEN-01-12C&D		

APPROXIMATE SCALE IN FEET



AZINE

REA



**FIGURE 6-35  
ORIENTATION OF CONTAMINANT  
PLUME CROSS SECTION A-A'  
PROPELLANT BURNING GROUND,  
LANDFILL 1,  
SETTLING PONDS AND  
SPOILS DISPOSAL AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.









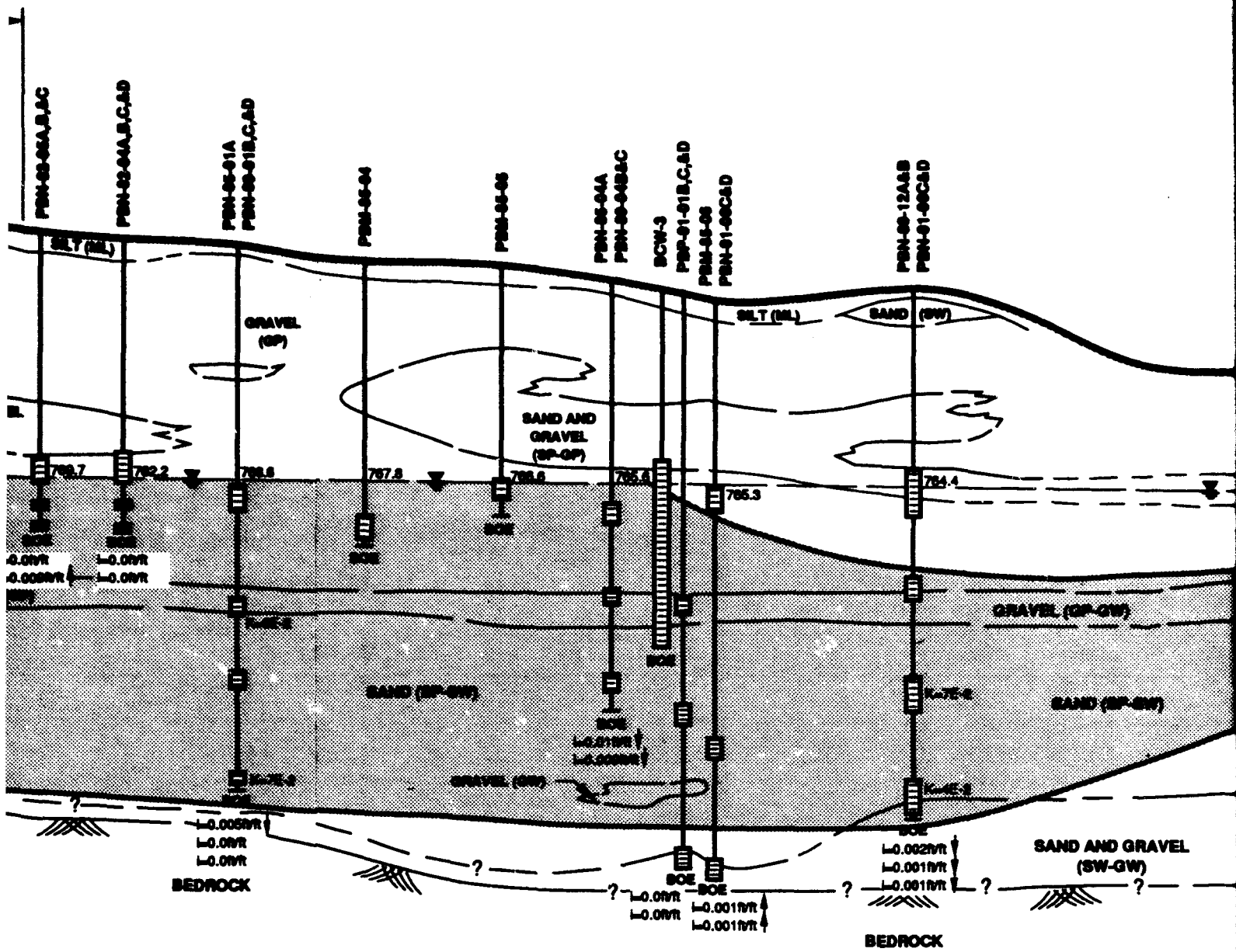












**NOTES:**

1. SEE FIGURE 2-2 FOR LOCATION AND ORIENTATION OF PROFILE.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. ON MULTIPLE WELL NESTS, GRADIENTS ARE LISTED IN ORDER OF SHALLOW TO DEEP WELLS; I.e., A TO B, B TO C AND C TO D.
4. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
5. BEDROCK SURFACE ELEVATION ESTIMATED FROM PBN-89-10 AND PRODUCTION WELL NO. 5.
6. BEDROCK SURFACE ELEVATION ESTIMATED FROM PBN-89-12D (LOCATED ADJACENT TO PBN-89-10), SPN-91-04D (LOCATED APPROXIMATELY 1200 FEET EAST OF SPN-91-03D), AND PRODUCTION WELL NO. 5 (LOCATED APPROXIMATELY 1000 FEET NORTH OF PBN-89-10).
7. PBP-91-01B,C,D IS USED ONLY FOR GEOLOGIC INFORMATION AND AQUIFER ANALYSIS. IT IS NOT A MONITORING WELL CLUSTER.

REFER TO WATER  
R (B,C,D)

CLASSIFICATION

RESULTS IN cm/sec

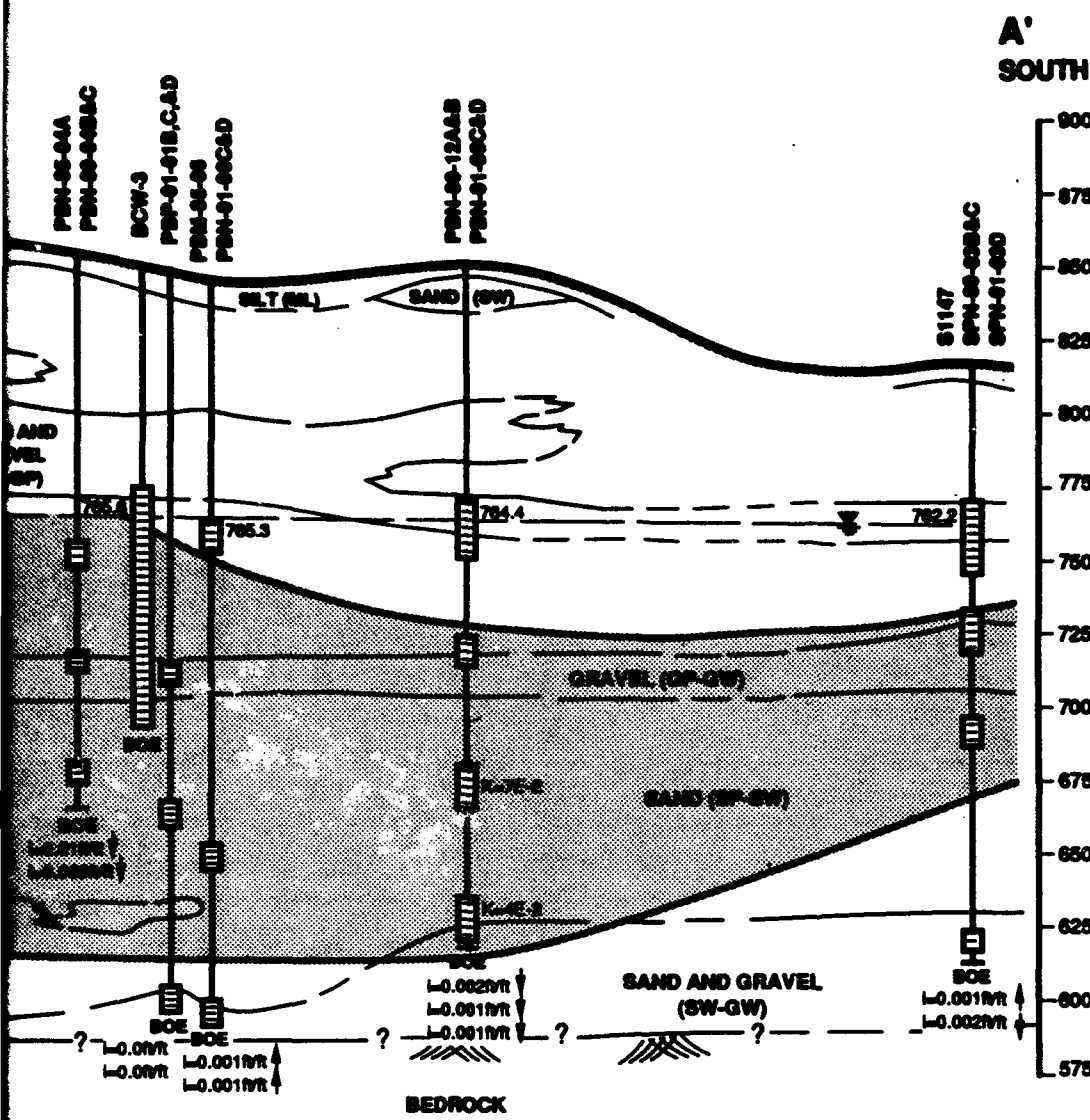
DIRECTION (ARROW)  
HYDRAULIC GRADIENT

TIME

**CONTAMINANT  
CROSS SECTION  
PROPELLANT BURNING  
SETTLING POND  
SPOILS DISPOSAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
DEPOSITORY**

ABB Environmental



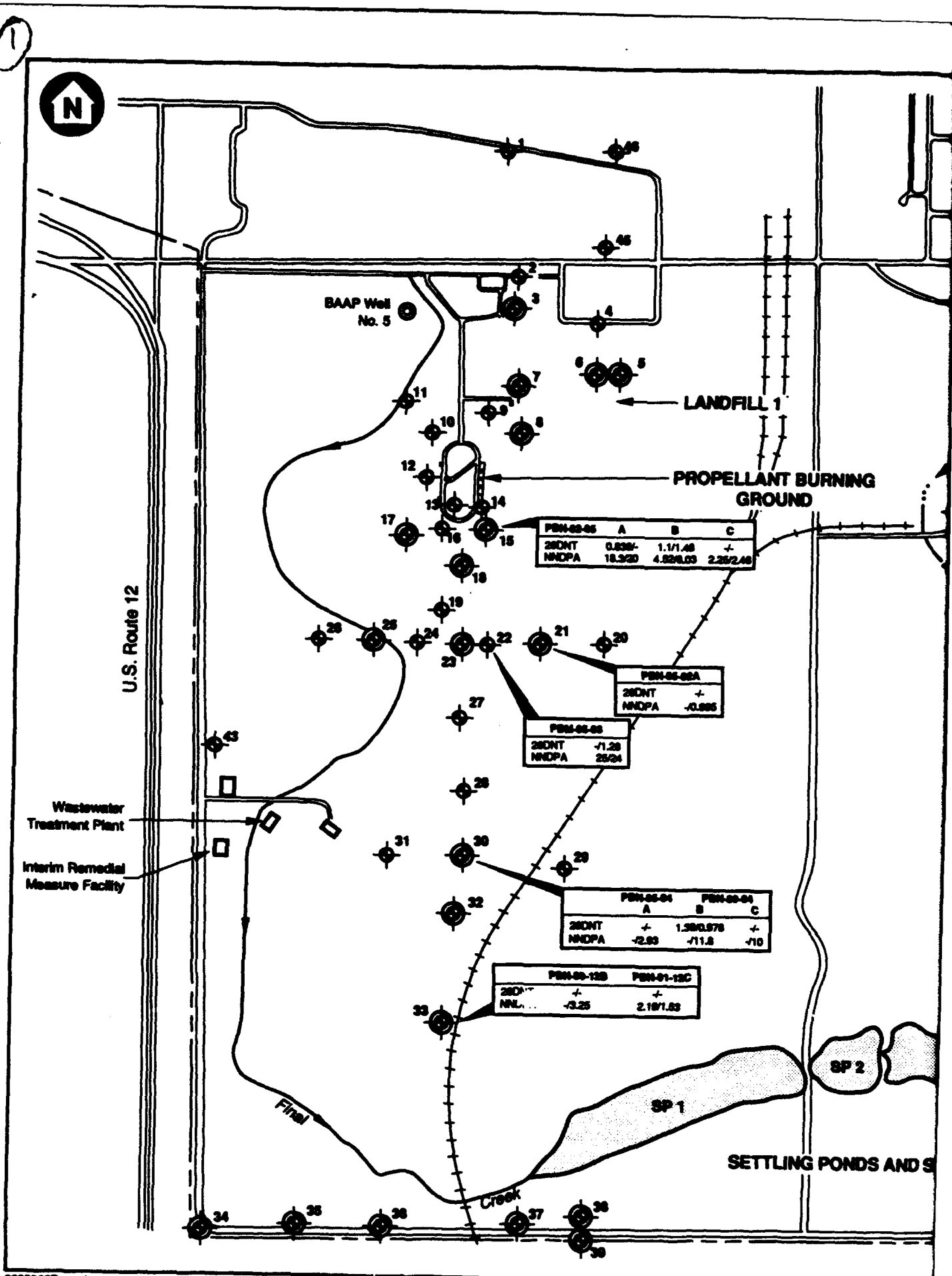


AND ORIENTATION OF PROFILE.  
 INTERPRETATION OF AVAILABLE SUBSURFACE  
 BETWEEN EXPLORATIONS MAY VARY FROM  
 IDENTITIES ARE LISTED IN ORDER OF SHALLOW  
 TO C AND C TO D.  
 WATER TABLE WELLS ON 12/15/91 ARE LISTED.  
 ESTIMATED FROM PBN-05-10 AND

ESTIMATED FROM PBN-05-12D (LOCATED  
 11-04D (LOCATED APPROXIMATELY 1200 FEET  
 PRODUCTION WELL NO. 5 (LOCATED  
 NORTH OF PBN-05-10).  
 FOR GEOLOGIC INFORMATION AND AQUIFER  
 RING WELL CLUSTER.

**FIGURE 6-37**  
**CONTAMINANT PLUME**  
**CROSS SECTION - TRCLE**  
**PROPELLANT BURNING GROUND,**  
**SETTLING POINDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**







2

WEST ROCKET  
PASTE AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE
1	PEN-00-11	20	PEN-00-00	34
2	PEN-00-09	21	PEN-00-00BAC	35
3	PEN-00-01A,B,C		PEN-00-00A	
4	LCN-00-01	22	PEN-00-00	36
5	LCN-00-00AB	23	PEN-00-01B,C,AD	37
6	LCN-00-00AB		PEN-00-01A	
7	PEN-00-00BAC	24	PEN-00-02	38
8	PEN-00-10A,B,C,AD	25	PEN-00-00BAC	39
9	PEN-00-02		PEN-00-00A	
10	S1144	26	PEN-00-05	40
11	PEN-00-01	27	PEN-00-04	41
12	PEN-00-00	28	PEN-00-05	42
13	PEN-00-04	29	PEN-00-00	43
14	PEN-00-00	30	PEN-00-00BAC	44
15	PEN-00-00A,B,C		PEN-00-01A	
16	S1117	31	PEN-00-07	45
17	PEN-00-00A,B,C	32	PEN-01-00C,AD	46
	S1140		PEN-00-00	47
18	PEN-00-01A,B,C	33	PEN-00-10AB	
19	PEN-00-01		PEN-01-10C,AD	



LANDFILL 1

PROPELLANT BURNING  
GROUND

B	C
1.1/1.48	+
4.02/0.03	2.25/2.46

PEN-00-00A
NT
SPA
-0.005

MAGAZINE

AREA

LEGEND

- SP I SETTLING PONDS AREA AND DESIGNATION
- SS II SPOILS DISPOSAL AREA AND DESIGNATION
- 1 LOCATION OF SINGLE MONITORING WELL
- 3 LOCATION OF MONITORING WELL
- SAMPLE LOCATION
- NNDPA
- COMPOUND CONCENTRATION
- COMPOUND CONCENTRATION
- COMPOUND OF CONCERN
- = LESS THAN CERTIFIED REPORTING LIMIT

NOTES:

1. ONLY DATA FROM WELLS IN WHICH EITHER 24DNT OR NNDPA WAS DETECTED ARE PRESENTED.
2. 24DNT WAS NOT DETECTED IN GROUNDWATER FROM ROUND ONE AND ROUND TWO.
3. BASE MAP FROM 300 SCALE SITE TOPOGRAPHY PROVIDED BY OLIN CORPORATION.

A	B	C
+	1.39/0.978	+
2.00	-11.8	-10

PEN-01-10C
+
2.10/1.03

SP 1

SP 2

SP 3

SS III

SP 4

41

40

42

SETTLING PONDS AND SPOILS DISPOSAL AREA

26DNT A  
DETECTED IN GROU  
PROPELLANT BURNING  
L  
SETTLING P  
SPOILS DISPO  
REMEDIAL INVE  
BADGER ARMY AMMUNIT  
ABB Environmental



CKET  
REA

Unarmed

AZINE

EA

REA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PBM-00-11	20	PBM-00-08	34	SPN-00-01C
2	PBM-00-09	21	PBM-00-08BAC		S1101 & S1128
3	PBM-00-01A,B,C		PBM-00-08A	35	SPN-00-08A,B,C
4	LOM-00-01	22	PBM-00-08		SPN-01-08D
5	LOM-00-02A,B	23	PBM-00-01B,C,D	36	SPN-00-08BAC
6	LOM-00-02A,B		PBM-00-01A		SPN-01-08D
7	PBM-00-02A,B,C	24	PBM-00-02		S1147
8	PBM-00-10A,B,C,D	25	PBM-00-08BAC	37	SPN-00-04BAC
9	PBM-00-02		PBM-00-02A		S1148, SPN-01-04D
10	S1144	26	PBM-00-05	38	S1102, S1103, S1148
11	PBM-00-01	27	PBM-00-04	39	S1104A,B
12	PBM-00-03	28	PBM-00-05	40	SPN-00-05A,B
13	PBM-00-04	29	PBM-00-06	41	S1110
14	PBM-00-06	30	PBM-00-04BAC	42	S1104, S1105, S1108
15	PBM-00-05A,B,C		PBM-00-04A	43	S1109
16	S1117	31	PBM-00-07	44	S1115, S1116
17	PBM-00-03A,B,C	32	PBM-01-08C&D	45	LOM-01-01
	S1148		PBM-00-08	46	LOM-01-02
18	PBM-00-04A,B,C	33	PBM-00-12A,B		
19	PBM-00-01		PBM-01-12C&D		

APPROXIMATE SCALE IN FEET



### LEGEND

SP 1



SETTLING PONDS AREA AND DESIGNATION

SS II



SPOILS DISPOSAL AREA AND DESIGNATION



LOCATION OF SINGLE MONITORING WELL



LOCATION OF MONITORING WELL NEST

PBM-00-12B	
NNDPA	-0.25

SAMPLE LOCATION

COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND ONE OF SAMPLING (NOV/DEC 1991)

COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND TWO OF SAMPLING (APR/MAY 1992)

COMPOUND OF CONCERN

- = LESS THAN CERTIFIED REPORTING LIMIT (CRL)

### NOTES:

1. ONLY DATA FROM WELLS IN WHICH EITHER 26DNT OR NNDPA WAS DETECTED ARE PRESENTED.
2. 24DNT WAS NOT DETECTED IN GROUNDWATER SAMPLES FROM ROUND ONE AND ROUND TWO.
3. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.

41

SS V

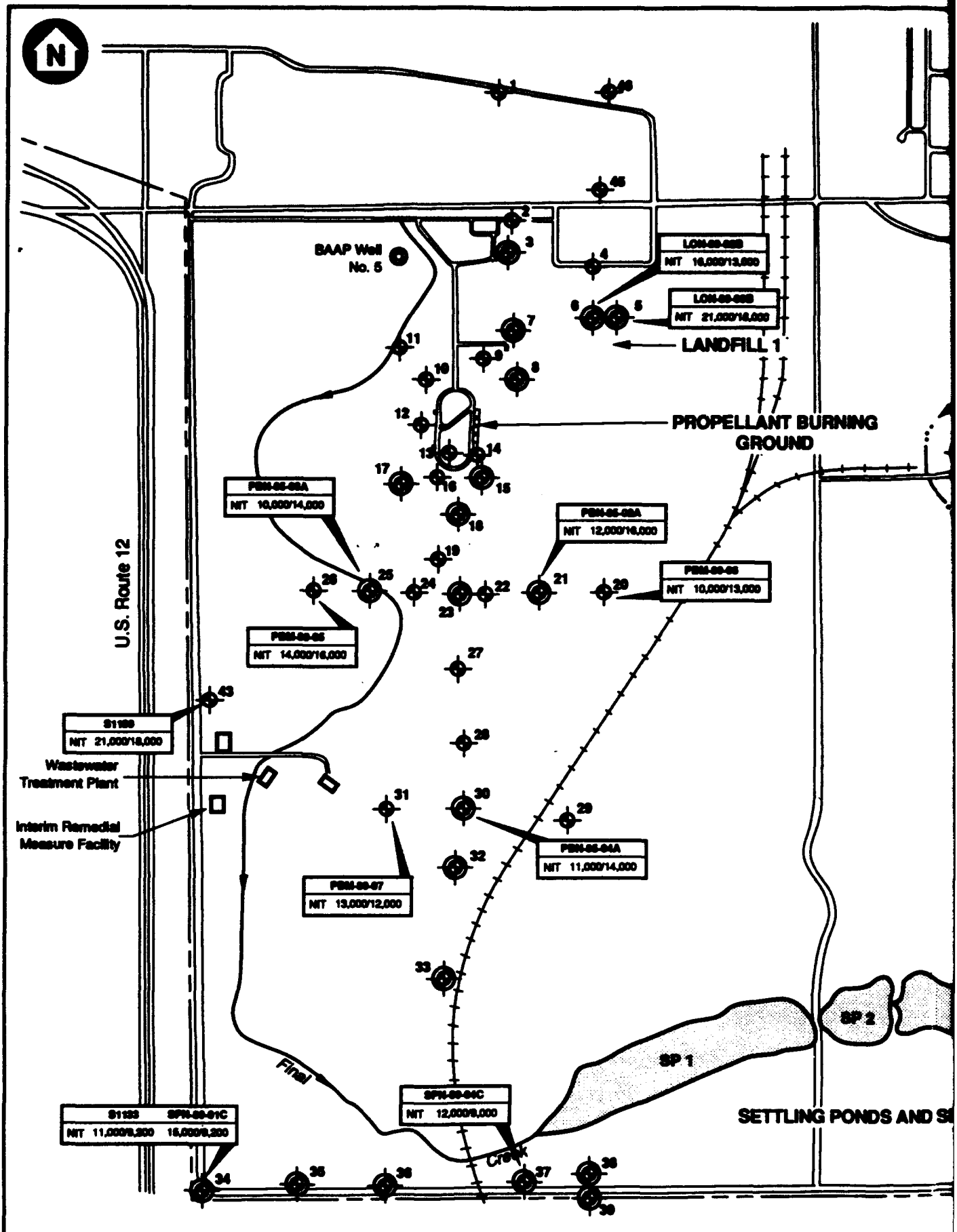
SP 4

40

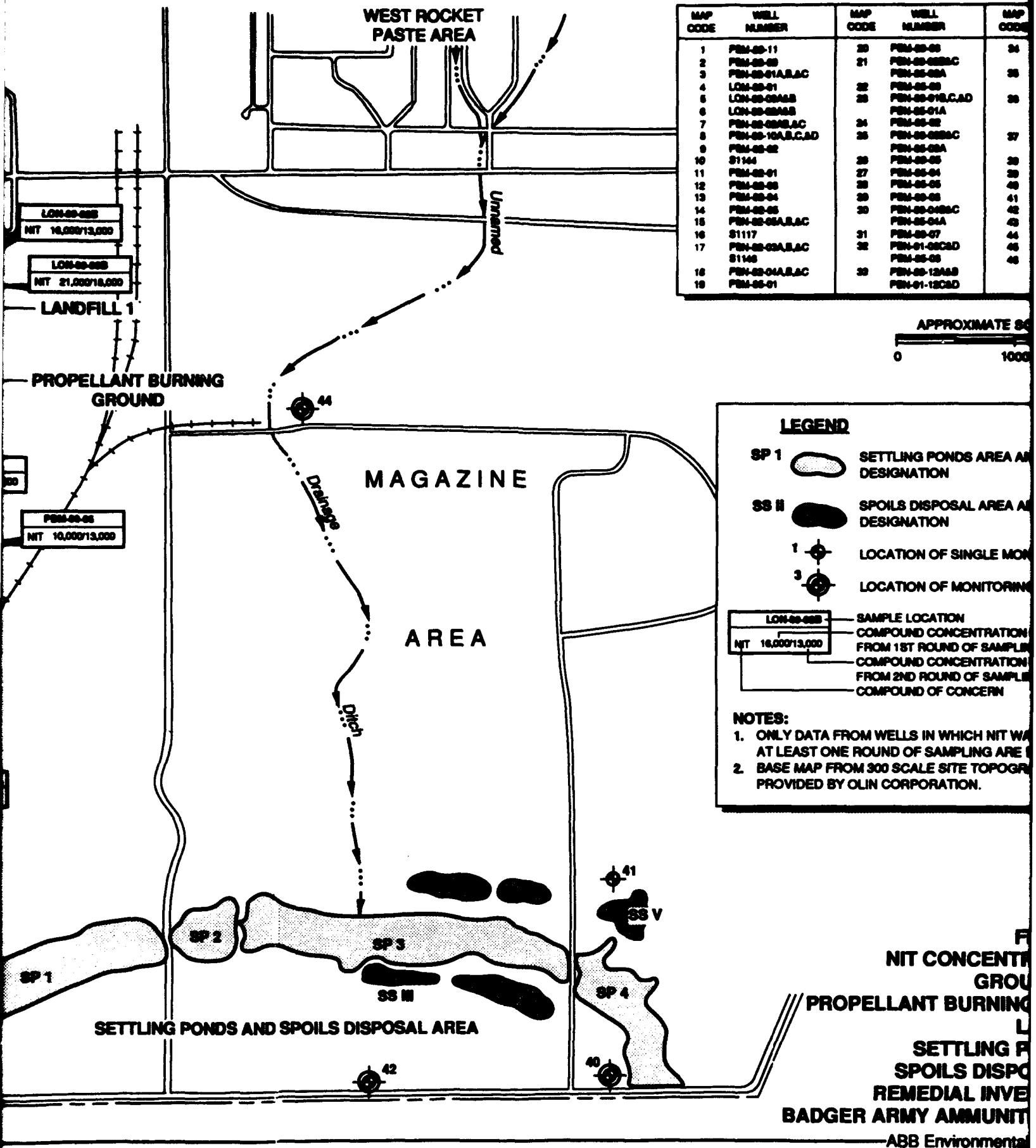
**FIGURE 6-38**  
**26DNT AND NNDPA**  
**DETECTED IN GROUNDWATER**  
**PROPELLANT BURNING GROUND,**  
**LANDFILL 1,**  
**SETTLING PONDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.











POCKET AREA

Unnamed

AZINE

REA

AREA

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
1	PBM-00-11	20	PBM-00-08	34	SPN-00-01C
2	PBM-00-09	21	PBM-00-08BAC		S1101 & S1102
3	PBM-00-01A,B,C		PBM-00-08A	35	SPN-00-08A,B,C
4	LCM-00-01	22	PBM-00-09		SPN-01-02D
5	LCM-00-02A,B	23	PBM-00-01B,C,D	36	SPN-00-08BAC
6	LCM-00-02A,B		PBM-00-01A		SPN-01-02D
7	LCM-00-02BAC	24	PBM-00-02		S1147
8	PBM-00-10A,B,C,D	25	PBM-00-08BAC	37	SPN-00-04BAC
9	PBM-00-02		PBM-00-08A		S1148, SPN-01-04D
10	S1144	26	PBM-00-05	38	S1102, S1103, S1149
11	PBM-00-01	27	PBM-00-04	39	S1102A,B
12	PBM-00-09	28	PBM-00-05	40	SPN-00-08A,B
13	PBM-00-04	29	PBM-00-05	41	S1110
14	PBM-00-05	30	PBM-00-04BAC	42	S1104, S1105, S1106
15	PBM-00-08A,B,C		PBM-00-04A	43	S1108
16	S1117	31	PBM-00-07	44	S1115, S1116
17	PBM-00-08A,B,C	32	PBM-01-08C&D	45	LCM-01-01
	S1146		PBM-00-09	46	LCM-01-02
18	PBM-00-04A,B,C	33	PBM-00-12A,B		
19	PBM-00-01		PBM-01-13C&D		

APPROXIMATE SCALE IN FEET



### LEGEND

- SP 1 SETTLING PONDS AREA AND DESIGNATION
- SS II SPOILS DISPOSAL AREA AND DESIGNATION
- 1 LOCATION OF SINGLE MONITORING WELL
- 3 LOCATION OF MONITORING WELL NEST
- LCM-00-02B SAMPLE LOCATION
- NIT 16,000/13,000 COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ ) FROM 1ST ROUND OF SAMPLING
- COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ ) FROM 2ND ROUND OF SAMPLING
- COMPOUND OF CONCERN

### NOTES:

- ONLY DATA FROM WELLS IN WHICH NIT WAS DETECTED IN AT LEAST ONE ROUND OF SAMPLING ARE PRESENTED.
- BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.

**FIGURE 6-39**  
**NIT CONCENTRATIONS IN**  
**GROUNDWATER**  
**PROPELLANT BURNING GROUND,**  
**LANDFILL 1,**  
**SETTLING PONDS AND**  
**SPOILS DISPOSAL AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



**TABLE 7-1**  
**SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

SITES	PROGRAM ELEMENTS			
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING
Deterrent Burning Ground	VOC-SST/MS, 110 collectors	GBHL at 4 wells, GPR and TC	7 new wells; 24 samples from 7 new and 5 existing wells	3 soil borings with a total of 44 analytical soil samples.
Existing Landfill	--	GBHL at 4 wells	14 new wells; 58 samples from 14 new and 15 existing wells	--

**Notes:**

GBHL = Geophysical Borehole Logging  
GPR = Ground Penetrating Radar  
TC = Terrain Conductivity  
VOC-SST/MS = Volatile Organic Compounds - Surface Static Trapping/Mass Spectrometry  
\* Includes 2 rounds of groundwater sampling



**TABLE 7-2**  
**SUMMARY OF BORINGS COMPLETED -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

<b>BORING NUMBER</b>	<b>DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)</b>	<b>TOTAL NUMBER OF SPLIT-SPOON SAMPLES</b>	<b>NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS</b>	<b>PURPOSE</b>
<u>Deterrent Burning Ground</u>				
DBB-91-01	117	19	16	Borings were made at the locations of the former Deterrent Burning Pits to provide chemical data to characterize the type and vertical distribution of contaminants in the unsaturated soils below the burning pits.
DBB-91-02	122	22	14	
DBB-91-03	122	22	14	



TABLE 7-3  
CHEMICAL ANALYSES PERFORMED ON SUBSURFACE SOIL SAMPLES -  
DETERRENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS												INORGANICS								OTHER				ORGANICS				
	METALS						TCLP METALS						ANIONS				TOC	pH	TPHC	VOC	BWA	MS	NAM	DNT					
	PP	TAL	CD	CR	HG	FE	NI	PB	CD	CR	HG	PB	NIT	SO4															
DETERGENT BURNING GROUND																													
D8B-91-01	16	--	--	--	--	--	--	--	16	16	16	16	16	16	--	--	--	16	16	16	16	16	16	16					
D8B-91-02	14	--	--	--	--	--	--	--	14	14	14	14	14	14	--	--	--	14	14	14	14	14	14	14					
D8B-91-03	14	--	--	--	--	--	--	--	14	14	14	14	14	14	--	--	--	14	14	14	14	14	14	14					
TOTALS	44	0	0	0	0	0	0	0	11	44	44	44	44	44	0	0	0	44	44	44	44	44	44	44					

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BWA = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography

USA010.WK1



**TABLE 7-4**  
**SUMMARY OF MONITORING WELLS INSTALLED -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

<b>SITE AND WELL IDENTIFIER</b>	<b>DILLING METHOD</b>	<b>BORING DEPTH FROM GROUND SURFACE (ft.)</b>	<b>BOTTOM ELEVATION OF SCREENS (ft. MSL)</b>	<b>LENGTH OF WELL SCREEN (ft.)</b>	<b>LOCATION</b>	<b>PURPOSE</b>
<b><u>Deterrent Burning Area</u></b>						
DBM-89-01	Dual-wall driven casing	127	771.99	20	Downgradient of Deterrent Burning Ground	To provide horizontal definition of the plume south of Deterrent Burning Ground.
DBN-89-02 A DBN-89-02 B	Dual-wall driven casing Dual-wall driven casing	120 160	767.10 731.90	20 5	Downgradient of Deterrent Burning Ground	To provide horizontal and vertical definition of the plume southeast of Deterrent Burning Ground.
DBM-89-03	Dual-wall driven casing	140	766.85	20	Downgradient of Deterrent Burning Ground	To provide horizontal definition of the plume southeast of Deterrent Burning Ground.
DBN-89-04 A DBN-89-04 B	Dual-wall driven casing Dual-wall driven casing	155 180	763.89 731.14	20 5	Upgradient of Deterrent Burning Ground	To define background conditions upgradient of Deterrent Burning Ground; there is a potential for contamination from either the Existing Landfill or the Oleum Plant.
DBM-89-05	Dual-wall driven casing	127	765.43	20	Downgradient of Deterrent Burning Ground	To provide horizontal definition of the plume south of Deterrent Burning Ground.
<b><u>Existing Landfill</u></b>						
ELM-89-01	Dual-wall driven casing	166	740.73	20	Downgradient of Existing Landfill	To provide horizontal plume definition downgradient and south of Existing Landfill.
ELN-89-02 A ELN-89-02 B	Dual-wall driven casing Dual-wall driven casing	160 180	773.10 741.19	20 5	Downgradient of Existing Landfill	To provide horizontal and vertical plume definition downgradient and south of Existing Landfill.
ELM-89-03	Dual-wall driven casing	180	765.28	20	Downgradient of Existing Landfill	To provide horizontal and vertical plume definition downgradient and southeast of Existing Landfill.



continued

TABLE 7-4  
SUMMARY OF MONITORING WELLS INSTALLED -  
DETERRENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
ELN-89-04 A ELN-89-04 B	Dual-wall driven casing Dual-wall driven casing	168 199	763.43 727.63	20 5	Downgradient of Existing Landfill	To provide horizontal and vertical plume definition downgradient and east of Existing Landfill.
ELM-89-05	Dual-wall driven casing	140	772.95	20	Potentially downgradient of Existing Landfill	To provide background water quality data upgradient of Existing Landfill.
ELN-89-06 B	Dual-wall driven casing	200	725.22	5	Downgradient of Existing Landfill	To provide horizontal and vertical definition of the plume downgradient of Existing Landfill in association with Existing Well S1153.
ELM-89-07	Dual-wall driven casing	170	764.19	20	Downgradient of ELM-89-03	To provide horizontal plume definition downgradient and southeast of Existing Landfill.
ELM-89-08	Hollow-stem augers	149	759.04	5	Downgradient of ELN-89-02A and ELN-89-02B	To provide horizontal plume definition downgradient and south of Existing Landfill.
ELM-89-09	Hollow-stem augers	160	765.79	5	Downgradient of Existing Landfill	To provide horizontal plume definition downgradient and west of Existing Landfill.
ELN-91-07 A ELN-91-07 B	Dual-wall driven casing Dual-wall driven casing	130 150	769.5 748.9	10 10	Downgradient of all Existing Landfill Wells	To document no impact conditions at downgradient edge of flow systems along BAAP boundary.
ELM-91-10	Dual-wall driven casing	154	766.8	15	Between ELN-89-04 and ELN-89-06 well nests.	To provide horizontal plume definition along BAAP boundary.

Notes:  
ft = feet  
MSL = Mean Sea Level

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**TABLE 7-5**  
**SUMMARY OF MONITORING WELLS LOGGED WITH BOREHOLE GEOPHYSICS -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITE/WELL No.</b>	<b>BORING DEPTH FROM TOP OF PVC RISER (feet)</b>	<b>APPROXIMATE DEPTH TO WATER FROM TOP OF PVC RISER (feet)</b>	<b>DATE LOGGED</b>	<b>DATE INSTALLED</b>	<b>DRILLING METHOD</b>
1. DBN-89-04B	190	141	05/09/89	02/07/89	Dual-wall driven casing
2. DBM-82-02	154	135	05/10/89	03/20/82	Mud rotary
3. DBN-89-02B	152	107	05/10/89	02/02/89	Dual-wall driven casing
4. ELM-89-09	157	140	05/10/89	04/13/89	Hollow-stem augers
5. ELN-89-02B	181	142	05/10/89	04/18/89	Dual-wall driven casing
6. ELM-89-03	151	138	05/11/89	01/25/89	Dual-wall driven casing
7. ELN-89-06B	182	130	05/11/89	04/04/89	Dual-wall driven casing
8. DBN-82-01C	169	128	05/11/89	03/22/82	Mud rotary
*DBN-89-04B	190	141	05/11/89	02/07/89	Dual-wall driven casing
9. ELN-82-02C	164	138	05/14/89	04/02/82	Mud rotary
10. ELN-89-04B	200	149	05/14/89	04/03/89	Dual-wall driven casing
11. ELN-82-03C	177	148	05/14/89	03/24/82	Mud rotary
12. ELM-89-08	147	127	05/14/89	04/01/89	Hollow-stem augers
*DBM-82-02	154	135	05/14/89	03/20/82	Mud rotary
*DBN-89-02B	152	107	05/14/89	02/02/89	Dual-wall driven casing
*ELM-89-09	157	140	05/14/89	03/01/89	Hollow-stem augers
*ELN-89-02B	181	142	05/14/89	04/18/89	Dual-wall driven casing

**Notes:**

\* Wells were relogged as part of the Quality Assurance/Quality Control Procedures.  
PVC = polyvinyl chloride



**TABLE 7-6**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	NEW WELLS	EXISTING WELLS
Deterrent Burning Ground	DBM-89-01 DBN-89-02A,B DBM-89-03 DBN-89-04A,B DBM-89-05	DBM-82-01 DBM-82-02 DBN-82-01B,C S1122
Subtotal	7	5
Existing Landfill	ELM-89-01 ELN-89-02A,B ELM-89-03 ELN-89-04A,B ELM-89-05 ELN-89-06B ELM-89-07 ELM-89-08 ELM-89-09 ELN-91-07A, B ELM-91-10	ELN-82-01A,B,C ELN-82-02A,B,C ELN-82-03A,B,C ELN-82-04A,B,C S1134 S1135 S1153
Subtotal	14	15
TOTAL WELLS	21	20

**Notes:**

A,B,C,D - Shallowest to deepest: A indicates shallowest well; D indicates deepest well in a well rest.



TABLE 7-7  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
DETERGENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS										INORGANICS				ANIONS				OTHER				ORGANICS				TPH
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	VOC	BVA	NG	NAM	DNT					
DETERGENT BURNING GROUND																											
DBM-82-01	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-82-02	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-89-01	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-89-02 A	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-89-02 B	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-89-03	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBM-89-05	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBN-82-01 B	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBN-82-01 C	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBN-89-04 A	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
DBN-89-04 B	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
S1122	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
EXISTING LANDFILL																											
ELM-89-01	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-89-03	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-89-05	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-89-07	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-89-08	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-89-09	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELM-91-10	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	B	B	B				
ELN-82-01 A	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-01 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-01 C	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-02 A	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-02 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-02 C	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-03 A	--	2	--	--	--	--	--	--	--	2	2	2	2	2	2	2	--	2	2	--	--	--	--				
ELN-82-03 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-03 C	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-04 A	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-04 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-82-04 C	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-89-02 A	--	2	--	--	--	--	--	--	--	2	2	2	2	2	2	2	--	2	2	--	--	--	--				
ELN-89-02 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				
ELN-89-04 A	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--				



TABLE 7-7  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
DETERRENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS													ORGANICS							TPH		
	METALS							ANIONS			OTHER			VOC				BN/A	MG	NAM		DNT	
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2						
ELN-89-04 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	--	--	--
ELN-89-06 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	--	--	--
ELN-91-07 A	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	B	B	B
ELN-91-07 B	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	B	B	B
S1134	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	--	--	--
S1135	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	--	--	--
S1153	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	--	--	--	B	B	--	--	--
TOTALS	24	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

## NOTES:

BN/A = base-neutral and acid-extractable organics by GC/MS

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

GC/MS = Gas Chromatography/Mass Spectrometry

HPLC = High Performance Liquid Chromatography

NAM = nitroamines by GC

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, FE, NI, SE, TL, ZN)

TAL = Toxic Analyte List (23) (AL, SE, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

B = Analyzed in both Rounds (One and Two).

1 = Analyzed in Round One only.

2 = Analyzed in Round Two only.

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**TABLE 7-8**  
**ELEVATION OF GLACIOLACUSTRINE UNIT -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>GROUNDWATER ELEVATION* FT. MSL</b>	<b>SCREEN ELEVATION FT. MSL</b>	<b>LACUSTRINE SILT AND CLAY ELEVATION AND COMMENTS FT. MSL</b>
DBM-89-01	780.14	788.6 to 768.6	767 to 775, silt with clay, some fine sand
DBN-89-02A	777.04	785.3 to 765.3	780 to 772, stratified silt, clay and sand
DBN-89-02B	776.94	739.8 to 734.8	
DBM-89-03	777.00	783.4 to 763.4	No silt and clay, silty sand above gravel at elevation 790
DBN-89-04A	780.25	782.5 to 762.5	752 to 748, silt and clay above sand and gravel
DBN-89-04B	776.79	735.9 to 730.9	
DBM-89-05	783.89	790.9 to 770.9	773, clay at bottom of boring
DBM-82-01	777.08	763.7 to 743.7	777 to 754, silty clay above fine to coarse sand
DBM-82-02	780.56	782.3 to 762.3	783 to 763, silty clay and fine sand
S1122	777.12	780.6 to 760.6	778 to 767, clayey silt with some fine sand and gravel
DBN-82-01B	777.06	748.2 to 746.2	
DBN-82-01C	777.13	739.7 to 737.7	
ELN-91-07A	774.88	779.5 to 769.5	No silt and clay, only gravelly soils at depth
ELN-91-07B	776.90	758.9 to 748.9	
ELM-91-10	777.11	781.8 to 766.8	Below 766.2 clayey silt with fine sand at bottom of boring
ELM-89-01	778.05	775.0 to 755.0	760 to 765, clayey silt above sand and gravel
ELN-89-02A	776.88	780.4 to 760.4	779 to 769, stratified clayey silt with fine sand
ELN-89-02B	776.24	744.5 to 739.5	
ELM-89-03	777.00	784.0 to 764.0	No silt and clay, fine-medium sand lenses at 754 to 744
ELN-89-04A	776.86	782.1 to 762.1	No silt and clay, fine sand above gravel at 745
ELN-89-04B	776.06	730.8 to 725.8	
ELM-89-05	777.47	785.2 to 765.2	No silt and clay, bottom of boring at 758
ELN-89-06B	776.73	729.1 to 724.1	No silt and clay, fine sand over gravel at 776
S1153	777.07		



continued

**TABLE 7-8**  
**ELEVATION OF GLACIOLACUSTRINE UNIT -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>GROUNDWATER ELEVATION* FT. MSL</b>	<b>SCREEN ELEVATION FT. MSL</b>	<b>LACUSTRINE SILT AND CLAY ELEVATION AND COMMENTS FT. MSL</b>
ELM-89-07	776.22	783.4 to 763.4	No silt and clay, only gravelly soils at depth
ELM-89-08	776.97	778.0 to 758.0	No silt and clay
ELM-89-09	779.21	784.6 to 764.6	No silt and clay, bottom of boring at 760
ELN-82-01A	777.82	780.5 to 770.5	773 to 771, clayey silt at bottom of boring
ELN-82-01B	777.76	760.6 to 758.6	
ELN-82-01C	777.44	751.0 to 749.0	
ELN-82-02A	777.39	781.8 to 771.8	749 to 751, silty clay observed in bottom of Deep "C" well
ELN-82-02B	777.43	764.7 to 762.7	
ELN-82-02C	777.41	753.1 to 751.1	
ELN-82-03A	777.28	780.2 to 770.2	772 to 770, silty clay observed at bottom of boring
ELN-82-03B	777.11	761.1 to 759.1	
ELN-82-03C	777.11	751.0 to 749.0	
ELN-82-04A	778.09	780.4 to 770.4	Silt and clay at elevation 771 in Warzyn cross section (Warzyn, 1982)
ELN-82-04B	777.83	758.5 to 756.5	
ELN-82-04C	777.27	750.2 to 748.2	

**Notes:**

\* Groundwater elevations measured on December 15, 1991  
FT MSL = feet, mean sea level



**TABLE 7-9**  
**VERTICAL GROUNDWATER GRADIENTS -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL NEST	WATER LEVEL DIFFERENCE (FT.)/SCREEN SEPARATION (FT.) <sup>4</sup>	VERTICAL GRADIENT AND DIRECTION (FT/FT)	COMMENT (WATER LEVEL DIFFERENCE)
DBN-89-04A and B <sup>1</sup>	3.46/40	0.09d <sup>2</sup>	Substantial
DBN-89-02A and B	0.10/37	0.003d <sup>3</sup>	Small
S1122 and DBN-82-01B	0.06/22	0.003d	Small
DBN-82-01B and C	0.07/10	0.007u	Small
ELN-91-07A and B	0.02/23	0.0009u	Insignificant
ELN-89-02A and B <sup>1</sup>	0.64/27	0.02d	
ELN-89-04A and B	0.80/44	0.02d	
ELN-89-06B and S1153	0.34/49	0.008d	
ELN-82-01A and B	0.06/16	0.004d	Small
ELN-82-01B and C <sup>1</sup>	0.32/9	0.04d	
ELN-82-02A and B	0.04/14	0.003u	Insignificant <sup>5</sup>
ELN-82-02B and C	0.02/11	0.002d	Insignificant
ELN-82-03A and B <sup>1</sup>	0.17/15	0.01d	Small
ELN-82-03B and C	0.00/10	0.00	No Difference
ELN-82-04A and B	0.26/18	0.01d	
ELN-82-04B and C <sup>1</sup>	0.56/8	0.07d	

**Notes:**

<sup>1</sup> Indicates well nest clearly screened across fine-grained lacustrine soils

<sup>2</sup> d = downward gradient

<sup>3</sup> u = upward gradient

<sup>4</sup> All measurements based on December 15, 1991 water level measurements.

<sup>5</sup> Both wells are above the glaciolacustrine unit

Water level differences were concluded to be insignificant at less than 0.05 ft.

Water level differences were concluded to be small at less than 0.2 ft.



**TABLE 7-10**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
DBM-89-01	1.5	$3 \times 10^{-2}$	Fine sand (SP) over silt and clay (ML)
DBN-89-02A	1.4	$8 \times 10^{-2}$	Silt and clay (CL-ML) over gravel (GP)
DBN-89-02B	2.5	$1 \times 10^{-1}$	Gravel with sand (GP)
DBM-89-03	0.9	$1 \times 10^{-1}$	Gravel with sand (GW-GP)
DBN-89-04A	2.0	$3 \times 10^{-2}$	Fine to medium sand with gravel (SP)
DBN-89-04B	2.2	$5 \times 10^{-2}$	Gravel with sand (GP)
DBM-89-05	3.4	$6 \times 10^{-3}$	Fine to medium sand (SP)
DBM-82-01	2.9	$7 \times 10^{-3}$	Silty clay and fine to coarse sand (CL-SP)
ELN-91-07A	1.8	$5 \times 10^{-3}$	Medium coarse sand with gravel (SW)
ELN-91-07B	6.5	$2 \times 10^{-2}$	Coarse to fine sand (SW)
ELM-91-10	1.5	$2 \times 10^{-2}$	Medium fine sand (SP)
ELM-89-01	3.6	$8 \times 10^{-3}$	Medium sand and silty sand (SP-SM)
ELN-89-04A	2.4	$4 \times 10^{-2}$	Fine sand with little gravel (SP)
ELN-89-04B	7.0	$1 \times 10^{-1}$	Gravel with little sand (GP)
ELM-89-05	2.4	$1 \times 10^{-2}$	Sand with gravel (SP-SW)
ELM-89-06B	8.0	$5 \times 10^{-2}$	Well graded gravel over fine sand (GW-SP)
ELM-89-07	1.2	$1 \times 10^{-1}$	Medium to fine gravel with some coarse sand (GP)
ELM-89-08	2.0	$4 \times 10^{-2}$	Sand with gravel (SP-GB)



continued

**TABLE 7-10**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
ELM-89-09	2.3	$3 \times 10^{-2}$	Sand (SP)
ELN-82-03C	5.1	$6 \times 10^{-3}$	Coarse to fine sand (SP)
ELN-82-04A	1.1	$3 \times 10^{-4}$	Medium fine sand (SM)
S1153	2.2	$5 \times 10^{-3}$	Medium fine sand, some gravel (SW-SM)

**Notes:**

Hydraulic Conductivity Tests completed during March and November, 1989, and November and December 1991.

Field data and calculations are presented in Appendix I.

Values for hydraulic conductivities represent an averaged value of multiple tests performed on each well.

Water level recovery at these wells impacted by inertial effects, resulting in water level recovery above static water levels. Hydraulic conductivity measurements may be greater than the calculated values at these wells.

cm/sec = centimeters per second



**TABLE 7-11**  
**HORIZONTAL GROUNDWATER GRADIENTS -**  
**DETERRENT BURNING GROUND/EXISTING LANDFILL**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL NEST	HORIZONTAL GRADIENT <sup>1</sup> AND DIRECTION (FT/FT)	COMMENT
DBM-82-02 ELM-89-09	0.004	Above lacustrine silt; northeasterly flow vector
DBM-89-05 ELM-89-01	0.005	Above lacustrine silt; northeasterly flow vector
DBN-89-04A ELN-82-04A	0.003	Above lacustrine silt; northeasterly flow vector
ELM-89-09 ELN-82-03A	0.002	Above lacustrine silt; easterly flow vector
ELM-89-08 ELN-91-07B	0.00005	Below lacustrine silt; east-southeasterly flow vector
ELN-82-03C ELN-89-06B	0.0008	Below lacustrine silt; east-southeasterly flow vector

**Notes:**

<sup>1</sup> All gradients based on December 15, 1991 water level measurement.

ft/ft = feet per foot



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA--  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91
DEPTH:	2.00	4.00	6.00	6.00	8.00	10.00	15.00	20.00	25.00	30.00	42.00	42.00
VOCs												
13DMB	-	-	-	-	-	-	0.290	0.584	-	-	-	-
C6H6	3.950	0.143	5.250	0.341	1.060	0.371	0.170	0.170	76.600	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-	-	-
MEC6H5	0.138	-	-	-	-	-	0.273	0.194	2.070	-	-	-
TXYLEN												
SVOCs												
2MNAP	-	-	-	-	-	-	-	-	-	-	-	-
26DNT	2700.000	3400.000	3700.000	10000.000	30000.000	4300.000	970.000	3300.000	12000.000	8.400	12.100	12.100
3NT	2.110	28.900	62.000 GT	62.000 GT	62.000 GT	6.440	6.050	940.000	62.000 GT	4.670	4.660	4.660
B2EHP	-	-	-	-	-	-	-	-	-	-	-	-
DEP	1.350	-	-	-	-	-	25.900	9.530	-	-	-	-
DNBP	-	-	-	-	-	-	62.000 GT	62.000 GT	-	-	-	-
FANT	-	-	46.500	62.000 GT	-	-	-	-	42.100	2.290	1.840	1.840
NNDMEA	-	-	-	-	-	-	0.018	-	-	-	-	-
NNDPA	4.700	98.000	127.000	2200.000	730.000	2400.000	-	1800.000	5200.000	1.740	1.040	1.040
PHANTR	-	-	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-	-	-
Metals												
AS	-	-	3.010	-	-	-	-	-	-	-	-	-
CR	3.640	2.440	5.900	2.930	2.410	1.910	1.980	1.980	2.240	1.410	3.940	3.940
CU	12.400	-	8.180	6.010	6.860	-	-	-	5.820	4.570	4.060	4.060
NI	3.390	-	4.510	4.430	3.980	-	-	-	-	-	3.190	3.190
PB	13.300	4.970	20.200	7.490	2.610	1.480	2.380	2.380	4.890	6.180	2.840	2.840
SE	-	-	-	-	-	-	-	-	-	-	-	-
ZN	16.500	8.860	18.200	6.400	6.350	2.720	3.610	3.610	6.800	4.780	9.370	9.370
NIT	6.090	13.200	15.300	18.700	12.900	2.610	2.880	2.880	3.500	1.050	1.410	1.410
SO4	-	-	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-01	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91
DEPTH:	44,000	52,000	72,000	92,000	112,000	117,000	120,000	120,000	120,000	120,000	120,000	120,000	120,000
VOCs													
13DMB	-	-	-	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs													
2MNAP	-	-	-	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-	-	-	-
26DNT	1.760	1.480	-	-	-	-	-	-	-	-	-	-	-
3NT	-	-	-	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-	-	-	-
NNDMEA	-	-	-	-	-	-	-	-	-	-	-	-	-
NNDPA	0.179	0.121	0.326	-	-	-	-	-	-	-	-	-	0.193
PHANTR	-	-	-	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals													
AS	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	3.950	3.660	2.960	2.090	2.040	2.820	-	-	-	-	-	-	-
CU	8.040	4.650	4.040	-	-	-	-	-	-	-	-	-	-
NI	3.680	-	-	-	-	-	-	-	-	-	-	-	-
PB	1.720	2.460	1.750	1.370	1.200	1.800	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-	-	-	-
ZN	7.070	4.220	3.830	-	4.090	4.280	-	-	-	-	-	-	-
Artenes													
NIT	-	-	-	2.050	-	-	-	-	-	-	-	-	-
SO4	-	-	8.130	12.700	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02	DBB-91-02
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91	10/15/91
DEPTH:	14.000	16.000	20.000	27.000	42.000	62.000	72.000	92.000	112.000	122.000		
VOCs												
13DMB	-	-	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-	-	-
MEC6HS	-	-	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs												
2MNAP	-	-	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	3.650	-	-	-	-	-	-	-	-
26DNT	-	-	-	0.558	-	-	-	-	-	-	-	-
3NT	-	-	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	1.620	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-	-	-
DNBP	-	-	-	2.980	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-	-	-
NNDMEA	-	-	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	0.093	-	0.168	-	0.081	-	-	-	-	0.098
PHANTR	-	-	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-	-	-
Metals												
AS	-	-	-	-	-	-	-	-	-	-	-	-
CR	2.900	1.580	2.730	2.960	3.830	2.510	2.150	3.050	3.680	3.240		
CU	-	-	4.380	5.330	6.590	3.200	-	-	3.550	-		
NI	-	-	-	-	3.680	-	-	-	-	-		
PB	0.699	0.874	1.500	1.610	1.810	1.810	0.946	0.737	1.220	0.987		
SE	-	-	-	-	-	-	-	-	-	-		
ZN	2.590	-	5.640	9.780	6.390	4.260	-	3.000	4.590	4.310		
NIT	5.270	3.510	3.320	2.210	1.800	1.470	1.780	2.170	1.970	2.580		
SO4	-	-	-	6.350	-	-	28.600	-	8.480	75.700		

Notes and flagging codes are presented at the end of this table.



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91
DEPTH:	4.000	8.000	12.000	14.000	16.000	18.000	20.000	22.000	24.000	26.000	28.000	30.000	32.000
VOCs													
13DMB	0.001 S	0.002 S	-	-	-	-	-	-	-	-	-	-	-
C6H6	-	0.002 S	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	-	-	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-	-	-	-
TXYLEN	-	-	-	-	-	-	-	-	-	-	-	-	-
2MNAP	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs													
24DNT	41.600	2900.000	790.000	6000.000	2400.000	13.700	6.210	1.830	-	-	-	-	-
26DNT	8.700	1400.000	1000.000	6.200 GT	6.200 GT	32.800	0.589	1.460	-	-	-	-	-
3NT	-	1.520	4.970	6.200 GT	2.190	-	-	-	-	-	-	-	-
B2EHP	1.530	1.160	4.350	5.790	1.600	0.850	-	2.090	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-	-	-	-
DNBP	3.250	2.990	-	6.200 GT	6.200 GT	2.170	-	-	-	-	-	-	1.500
FANT	0.139	-	-	-	-	-	-	-	-	-	-	-	-
NNDMEA	-	-	-	-	-	-	-	-	-	-	-	-	-
NNDPA	7.660	24.000	150.000	820.000	280.000	10.500	-	1.140	-	-	-	-	-
PHANTR	0.183	-	-	-	-	-	-	-	-	-	-	-	-
PYR	0.144	-	-	-	-	-	-	-	-	-	-	-	-
Metals													
AS	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	7.950	7.320	7.410	2.820	2.150	3.870	2.490	2.270	3.080	4.060	-	-	-
CU	23.100	12.300	8.800	3.780	-	3.980	3.300	3.290	4.050	5.170	-	-	-
NI	5.280	3.340	4.940	-	-	-	-	-	-	-	-	-	-
PB	7.000	3.820	5.390	1.150	1.600	2.430	1.680	1.740	2.220	1.400	-	-	-
SE	-	-	-	-	-	-	-	-	-	-	-	-	-
ZN	13.300	16.900	10.400	4.760	3.860	5.410	2.970	5.200	5.440	6.360	-	-	-
NIT	2.510	8.020	8.910	13.000	4.220	5.820	4.990	1.880	1.610	1.700	-	-	-
SO4	-	-	-	-	-	-	240.000	150.000	86.400	29.900	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03	DBB-91-03
Sample Type:	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91
DEPTH:	62,000	82,000	102,000	102,000	122,000
<b>VOCs</b>					
13DMB	-	-	-	-	-
C6H6	-	-	-	-	-
CH2CL2	-	-	-	-	-
MEC6H5	-	-	-	-	-
TXYLEN	-	-	-	-	-
<b>SVOCs</b>					
2MNAP	-	-	-	-	-
24DNT	-	-	-	-	-
26DNT	-	-	-	-	-
3NT	-	-	-	-	-
B2EHP	-	-	-	-	-
DEP	-	-	-	-	-
DNBP	-	-	-	-	-
FANT	-	-	-	-	-
NNDMEA	-	-	-	-	-
NNDPA	-	-	-	-	-
PHANTR	-	-	-	-	-
PYR	-	-	-	-	-
<b>Metals</b>					
AS	-	-	-	-	-
CR	3,230	3,880	12,100	3,820	-
CU	3,900	4,670	9,540	-	-
NI	-	2,900	3,730	-	-
PB	1,330	1,230	4,220	0,986	-
SE	-	-	-	-	-
ZN	5,630	5,500	106,000	6,640	-
<b>Anions</b>					
NIT	2,290	1,550	1,840	2,130	-
SO4	110,000	-	-	54,300	-

Notes and flagging codes are presented at the end of this table.



TABLE 7-12  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
DETERRENT BURNING GROUND/ EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range but within acceptable limits

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RI Report Glossary



**TABLE 7-13**  
**SUMMARY OF TCLP METALS DATA FOR SUBSURFACE SOIL -**  
**DETERRENT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SAMPLE LOCATION	DEPTH	TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )				NOTES
		CD	CR	PB	HG	
TCLP RL <sup>1</sup>		1,000	5,000	5,000	200	
Minimum Reporting Value		6.8	16.8	43.4	0.1	
DBB-91-01	2	LT	LT	LT	0.9	TCLP RL not exceeded
DBB-91-01	4	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	6	LT	LT	LT	0.2	TCLP RL not exceeded
DBB-91-01	8	LT	LT	LT	0.3	TCLP RL not exceeded
DBB-91-01	10	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	15	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	20	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	25	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	30	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	42	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	44	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	52	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	72	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	92	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	112	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-01	117	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	4	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	6	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	8	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	10	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	14	LT	LT	LT	0.8	TCLP RL not exceeded
DBB-91-02	16	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	20	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	27	LT	LT	LT	0.2	TCLP RL not exceeded



continued

**TABLE 7-13**  
**SUMMARY OF TCLP METALS DATA FOR SUBSURFACE SOIL -**  
**DETERRENT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SAMPLE LOCATION	DEPTH	TCLP LEACHATE CONCENTRATION ( $\mu\text{g}/\text{L}$ )				NOTES
		CD	CR	PB	HG	
DBB-91-02	42	LT	LT	LT	0.2	TCLP RL not exceeded
DBB-91-02	62	LT	LT	LT	0.8	TCLP RL not exceeded
DBB-91-02	72	LT	21.8	LT	0.3	TCLP RL not exceeded
DBB-91-02	92	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	112	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-02	122	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	4	LT	35.9	LT	LT	TCLP RL not exceeded
DBB-91-03	8	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	12	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	14	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	16	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	18	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	20	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	22	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	27	7.9	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	42	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	62	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	82	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	102	LT	LT	LT	LT	TCLP RL not exceeded
DBB-91-03	122	LT	LT	LT	LT	TCLP RL not exceeded

**Notes:**

- <sup>1</sup> TCLP Regulatory Levels (RLs) exist for the following metals: AS, BA, CD, CR, SE, PB, HG, and AG. However, these results were reported only for CD, CR, PB, and HG. (List of USATHAMA Chemical Codes for definitions of chemical abbreviations).



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBM-82-01	DBM-82-02	DBM-89-01	DBM-89-03	DBM-89-05
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/10/91	04/11/92	12/09/91	12/10/91	04/11/92
ROUND:	ONE	TWO	ONE	ONE	TWO
VOCs					
11TCE	-	-	8.34	-	-
13DMB	-	-	-	-	-
CH2CL2	4.31	7.75	5.49	5.1	4.300 S
CHCL3	-	-	-	-	5.39
MEC6HS	-	-	-	-	-
SVOCs					
2BUXEL	-	-	-	-	5.460 P
2E1HXL	-	-	5.5	-	-
26DNT	2.17	1.29	-	-	-
B2EHP	27.1	-	-	-	-
NNDPA	16.7	14.5	-	-	-
Metals					
CD	-	-	-	-	-
CR	6.74	-	9.98	4.98	-
CU	-	-	6.69	-	-
ZN	-	-	-	-	-
Anions					
NIT	16000	2600	4400	6700	6600
CL	5100	5200	29000	5600	3600
SO4	30000	32000	450000	25000	31000
Indicator	311000	289000	514000	266000	280000
parameter	278000	298000	818000	254000	248000
TDS	328000	300000	1090000	281000	313000
pH(1)	7.4	7.2	7.1	7.6	7.7
Sp.Cond.(2)	510	494	1072	422	529
			417	472	488

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBN-82-01B	DBN-82-01C	DBN-89-02A	DBN-89-02B	DBN-89-04A
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/07/91	12/09/91	12/12/91	12/12/91	12/07/91
ROUND:	ONE	TWO	ONE	ONE	ONE
VOCs					
111TCE	-	-	-	-	3.730 P
13DMB	-	-	-	-	-
CH2CL2	5.2 P	5.88 B	4.8 P	4.51 P	5.100 P
CHCL3	-	0.563 P	0.614 P	-	-
MECOHS	-	-	-	-	-
SVOCs					
2BUXEL	-	-	-	-	-
2E1HXL	-	-	-	20 S	-
26DNT	-	-	-	-	-
B2EHP	-	66.9	-	43 P	-
NNDPA	-	-	-	-	-
Metals					
CD	-	-	3.23	-	-
CR	-	-	8.74	13.4	8.1
CU	-	-	6.41	77.2	-
ZN	-	-	-	-	-
Anions					
NIT	2900	3600	3400	2100	6800
CL	4100	7200	6900	9400	3600
SO4	29000	32000	26000	34000	20000
Indicator	294000	154000	230000	150000	284000
parameter	238000	177000	306000	190000	324000
TDS	209000	217000	321000	260000	327000
pH(1)	7.6	7.8	7.7	7.6	7.3
Sp.Cond.(2)	434	316	462	343	572
					548

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	DBN-89-04B	WELL	S1122
Sample Type:	ONE	TWO	WELL
UNITS:	12/07/91	04/10/92	UCL
DATE SAMPLED:	ONE	TWO	ONE
ROUND:	ONE	TWO	TWO
VOCs	111TCE -	-	-
	13DMB -	-	-
	CH2CL2 5.29	7.75 B	5.29
	CHCL3 -	-	-
	MEC6HS -	-	-
SVOCs	2BUXEL	-	-
	2E1HXL 50 S	-	-
	26DNT -	-	-
	B2EHP 87.6	27 P	28 P
	NNDPA -	-	-
Metals	CD -	-	-
	CR 6.64	-	7.81
	CU -	-	5.43
	ZN -	-	-
Anions	NIT 5600	9200	3300
	CL 4800	6900	6400
	SO4 25000	23000	28000
Indicator	ALK 222000	250000	198000
parameter	HARD 280000	304000	326000
	TDS 209000	331000	359000
	pH(1) 7.6	7.4	7.1
	Sp.Cond.(2) 491	505	622
			386

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample type: DATE SAMPLED: ROUND:	ELM-89-01			ELM-89-03			ELM-89-05			ELM-89-07			ELM-89-08		
	ONE	TWO	UGL	ONE	TWO	UGL	ONE	TWO	UGL	ONE	TWO	UGL	ONE	TWO	UGL
VOCs															
11TCE	4.06 P	5.6													
12TCE	-	-		-	-		-	-		0.462 P	-		-	-	
12DMB	-	-		-	-		-	-		5.9 S	-		-	-	
13DMB	-	-		-	-		-	-		-	-		-	-	
ACET	-	-		-	-		-	-		-	-		-	-	
C6H6	-	-		-	-		-	-		-	-		-	-	
CH2CL2	4.41 P	5.78 B		5.0 P	7.25 B		5.49	7.84 B		4.8 P	5.88 B		5.1 P	6.86 B	
CH3CL	-	-		-	-		-	-		-	-		-	-	
CHCL3	-	-		-	-		-	-		-	-		-	-	
MEC6HS	-	-		-	-		4.72 P	-		5.28 P	-		-	-	
MEK	-	-		-	-		-	-		-	-		-	-	
TCLEE	-	-		-	-		-	-		-	-		-	-	
TRCLE	-	-		-	-		-	-		-	-		-	-	
SVOCs															
2EHXL	-	-		-	-		0.382 P	-		-	-		-	-	
4MP	-	-		-	-		-	-		-	-		-	-	
BZEHP	41.4 P	-		-	130		-	-		-	-		28 P	-	
PHENOL	-	-		-	-		-	-		-	-		-	-	
TRIMBZ	-	-		-	-		-	-		4 S	-		-	-	
Metals															
AG	-	-		-	-		-	-		-	-		-	-	
BA	58.0	51		48	30.6		32.2	32.2		30.4	31.3		28.2	26.9	
BE	-	-		-	-		-	-		-	-		-	-	
CA	100000 GT	180000		83000	75000		85000	81000		70000	72000		61000	67000	
CR	19.5	-		8.67	-		13.8	-		7.04	-		5.81	-	
CU	-	-		-	-		-	-		-	4.7		-	-	
FE	150	-		31.9	-		42.3	-		39.0	-		37.0	-	
HG	-	-		-	-		-	4.25		-	-		-	-	
K	1730	1550 T		1200 T	2720 T		992 T	2260 T		1320 T	1590 T		1110 T	1260 T	
MG	50000 GT	110000		44000	38000		50000	44000		39000	40000		32000	34000	
MN	-	-		-	-		-	-		-	-		-	-	
NA	-	30000 T		-	13000 T		-	10000 T		-	12000 T		-	14000 T	
NI	-	-		-	-		-	-		-	-		-	-	
PB	-	-		-	-		5.94	-		-	-		-	-	
SE	-	-		-	-		-	-		-	-		-	-	
V	-	15.6		-	-		-	-		-	-		-	-	
ZN	-	-		-	-		-	-		-	9.85		-	7.22	
Anions															
NIT	4800	4300		2900	1300		5500	2600		3000	1700		8000	8000	
CL	21000	20000		8200	7700		15000	15000		6000	7600		6600	7600	
SO4	340000	330000		47000	44000		26000	25000		39000	46000		28000	29000	
Indicator	ALK	424000		316000	288000		354000	357000		286000	298000		248000	246000	
parameter	HARD	730000		570000	346000		348000	416000		316000	336000		256000	296000	
TDS	1010000	928000		380000	359000		348000	413000		328000	352000		283000	311000	
pH(1)	7.5	6.9		7.4	7.3		7.4	7.5		7.5	7.8		7.6	7.9	
SpCond(2)	1018	724		546	565		556	612		564	537		517	490	

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	FLM-59-09	ELM-91-10	ELN-82-01A	ELN-82-01B	ELN-82-01C
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNIT:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/10/91	04/09/92	11/25/91	04/09/92	11/25/91
ROUND:	ONE	TWO	ONE	TWO	ONE
VOXs					
11TCE	3.07 P	7.68	-	-	-
112TCE	0.365 P	-	-	-	-
12DMB	-	-	-	-	-
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
C6H6	-	-	-	-	-
CH2CL2	4.41 P	B	5.59	5.98 B	4.61 P
CH3CL	-	-	-	-	-
CHCL3	-	-	-	-	-
MEC6H5	-	-	-	-	-
MEK	-	-	-	-	-
TCLFE	-	-	-	-	-
TRCLE	-	-	-	-	-
SVOCs					
2E1HXL	-	-	-	-	-
4MP	-	-	-	-	-
B2EHP	44.6 P	-	-	43.8 P	-
PHENOL	-	-	-	-	-
TRIMBZ	-	-	-	-	-
Metals					
AG	-	-	0.517	-	-
BA	68	70.0	97	15.4	41.7 X
BE	-	0.362	-	-	25.5
CA	100000 GT	130000	100000	6000000	6200000
CR	13	15.6	15.6	10.8	8.48
CU	-	5.33	6.41	7.96	4.77
FE	51.7	-	25.8	69.0	488
HG	-	-	-	-	-
K	4900	10000	2530	2380	2610
MG	50000 GT	120000	50000	GT X 11000000	3500000
MN	-	-	73.3	28.3	127
NA	24000	25000	19000	24000	2890
NI	-	-	-	-	9.69
PB	-	-	-	-	-
SE	-	-	-	-	-
V	-	-	-	19.1	4.82
ZN	-	-	-	25.6	300
Asbestos					
NI	900	7200	1900	550	700
CL	15000	17000	30000	35000	3900
SO4	340000	330000	200000	190000	27000
Indicator					
ALK	58000	494000	534000	710000	225000
HARD	706000	754000	366000	902000	244000
TDS	963000	887000	892000	977000	273000
pH(1)	7.0	7.0	7.1	7.0	7.0
Sp. Cond.(2)	1138	1081	1079	1260	477

Notes and flagging codes are presently at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	ELN-82-02A	ELN-82-02B	(3) ELN-82-02C	ELN-82-03A	ELN-82-03B	ELN-82-03C
Sample Type:	WELL	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/09/91	04/26/92	12/09/91	04/11/92	11/25/91	04/11/92
ROUND:	ONE	TWO	ONE	TWO	ONE	TWO
VOCs						
111TCE	-	-	-	-	-	-
112TCE	-	-	-	-	0.702	-
12DMB	-	-	-	-	-	-
13DMB	4.6	-	3.2	-	-	-
ACET	-	-	-	-	-	-
C6H6	-	-	-	-	-	-
CH2CL2	4.9	7.84	5.0	7.25	6.08	7.06
CH3CL	-	-	-	-	-	-
CHCL3	-	-	-	-	-	-
MEC6H5	4.81	-	-	-	-	-
MEK	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-
TRCLE	-	0.605	-	-	-	-
SVOCs						
2EHXL	-	-	-	-	-	-
4MP	-	-	-	-	27.1	-
B2HP	43.8	46.2	127	-	-	-
PHENOL	-	-	-	-	-	-
TRIMBZ	-	-	-	-	-	-
Metals						
AG	-	-	-	-	-	-
BA	130	130	87.0	110	18.9	13.7
BE	-	0.627	-	0.918	0.706	0.372
CA	100000	180000	100000	19000000	1000000	120000
CR	13.9	-	10.4	-	12.7	-
CU	-	-	11.7	4.83	-	-
FE	253	310	41.3	-	-	-
HG	-	-	-	-	-	-
K	1170	2250	1820	2350	1630	24000
MG	50000	77000	50000	8400000	5000000	61000
MN	350	480	131.0	144	9.98	-
NA	-	33000	18000	27000	20000	21000
NI	-	20.7	18.5	-	-	-
PB	-	-	-	-	-	-
SE	-	-	-	-	4.03	-
V	-	-	-	-	4.51	-
ZN	760	144	460	33.2	61.5	-
Anions						
NIT	2300	290	1900	250	1900	1200
CL	69000	38000	20000	37000	19000	15000
SO4	63000	59000	44000	58000	200000	220000
Indicator						
ALK	628000	558000	396000	708000	364000	364000
HARD	670000	596000	522000	776000	558000	552000
TDS	870000	636000	500000	825000	691000	648000
pH(1)	6.8	6.9	6.8	7.1	7.4	7.3
Sp. Cond.(2)	1330	1208	969	118	802	879

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/ EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	ELN-82-03C	ELN-82-04A	ELN-82-04B	ELN-82-04C	ELN-89-02A	ELN-89-02B
Sample Type:	WELL	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	04/11/92	12/05/91	04/10/92	12/05/91	04/13/92	04/12/92
ROUND:	TWO	ONE	TWO	ONE	TWO	ONE
VOCs						
111TCE	-	-	-	-	-	-
112TCE	-	-	-	-	-	-
12DMB	-	-	-	-	-	-
13DMB	-	-	-	-	-	-
ACET	-	-	-	-	-	-
C6H6	-	-	-	-	-	-
CH2CL2	7.16 B	4.31 P	5.39 B	3.82 P	8.43 B	7.06 B
CH3CL	-	-	-	-	-	-
CHCL3	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	0.875
MEK	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-
SVOCs						
2E1HXL	-	-	-	-	-	-
4MP	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-
PHENOL	-	-	-	-	-	-
TRIMBZ	-	-	-	-	-	-
Metals						
AG	-	-	-	-	-	-
BA	17.5	73	67	26.3	25.4	29.3
BE	-	-	-	-	-	-
CA	73000	120000 X	120000 X	65000	38000	470000
CR	-	7.15	-	48.5	5.14	140
CU	-	8.46	11.9	8.2	4.89	5.22
FE	-	77.3	29.9	296	38.3	29.4
HG	-	-	-	-	-	-
K	2640 T	1640 T	2860 T	1150 T	21000 T	8700 T
MG	39000	52000	47000	45000	32000	35000
MN	-	13.3	-	14.3	-	-
NA	13000 T	3290 T	10000 T	-	13000 T	15000 T
NI	-	-	9.45	24.4	-	-
PB	-	-	-	-	-	-
SE	-	-	-	-	-	-
V	-	-	-	-	-	-
ZN	-	2300	3900	-	-	-
Antions						
NIT	1100	5800	4000	3700	2400	4000
CL	6200	4600	3500	2900 P	7200	13000
SO4	57000 X	29000	31000	28000	28000	29000
Indicator	ALK	474000	450000	238000	245000	622000
parameter	HARD	318000	468000	320000	210000	1120000
TDS	371000	513000	496000	355000	279000	435000
pH(1)	7.6	6.0	6.9	6.0	7.4	9.8
Sp.Cond.(2)	590	601	695	426	497	340
			468			462
						452

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	(4) ELN-89-04A				ELN-89-06B				ELN-91-07A				ELN-91-07B			
Sample Type:	WELL				WELL				WELL				WELL			
UNITS:	UGL				UGL				UGL				UGL			
DATE SAMPLED:	12/05/91	04/27/92	12/05/91	04/25/92	12/08/91	04/10/92	12/08/91	04/11/92	12/08/91	04/11/92	12/08/91	04/11/92	12/08/91	04/11/92	12/08/91	04/11/92
ROUND:	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO
VOCs																
111TCE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
112TCE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12DMB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13DMB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C6H6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	4.8	7.65	B	6.08	B	5.29	7.75	B	5.98	B	5.1	P	5.49	B	-	-
CH3CL	3.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHCL3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MEC6HS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MEK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TCLEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2E1HXL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs																
4MP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BZHP	28.7	P	43.8	P	193	63.7	-	-	-	-	-	-	-	-	-	-
PHENOL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRIMBZ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																
AG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BA	110	130	22	34.4	19	16.5	33.3	24.7	33	28.8	-	-	-	-	-	-
BE	-	0.811	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CA	100000	GT	72000	80000	76000	72000	74000	79000	96000	80000	-	-	-	-	-	-
CR	12.7	-	7.79	-	12.7	-	6.3	-	8.81	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FE	36.2	-	48.4	-	37.4	-	68.1	-	42.8	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	1380	1980	1220	1510	1130	19000	1990	1930	1490	1480	-	-	-	-	-	-
MG	50000	GT	39000	43000	45000	41000	43000	43000	50000	44000	-	-	-	-	-	-
MN	232	148	-	-	-	-	16.4	-	8.89	-	-	-	-	-	-	-
NA	19000	T	-	8400	T	13000	-	15000	T	16000	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	5.94	-	-	-	-	-	-	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ZN	40.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ambas																
NIT	160	130	1800	2700	3000	960	4500	2800	2800	1000	-	-	-	-	-	-
CL	30000	32000	8200	11000	8500	7900	33000	36000	8500	9300	-	-	-	-	-	-
SO4	65000	69000	31000	30000	54000	51000	20000	17000	50000	52000	-	-	-	-	-	-
Indicator																
ALK	580000	724000	254000	268000	212000	307000	346000	318000	366000	316000	-	-	-	-	-	-
Hard	754000	792000	328000	382000	332000	368000	250000	342000	446000	356000	-	-	-	-	-	-
parameter	841000	863000	352000	305000	372000	367000	332000	344000	340000	365000	-	-	-	-	-	-
TDS	7.0	7.0	8.0	7.6	7.5	7.6	7.5	7.6	7.4	7.7	-	-	-	-	-	-
pH(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sp Cond(2)	1568	1192	587	611	642	534	523	639	506	608	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
DETERRENT BURNING GROUND/EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1134	S1135	S1153
Sample Type:	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL
DATE SAMPLED:	12/04/91	12/06/91	04/28/92
ROUND:	ONE	TWO	TWO
VOCs	111TCE	-	-
	112TCE	2.31	-
	12DMB	-	-
	13DMB	-	-
	ACET	-	-
	C6H6	-	-
	CH2CL2	5.2 P	7.55 B
	CH3CL	3.24 P	3.63 P
	CHCL3	-	-
	MEC6H5	-	-
	MEK	-	-
	TCLEE	-	-
	TRCLE	0.276 P	-
SVOCs	2E1HXL	-	-
	4MP	-	-
	B2EHP	139	73.6
Metals	PHENOL	-	-
	TRIMBZ	-	-
	AG	-	-
	BA	28.9	24
	BE	-	-
	CA	100000 GT	100000 GT
	CR	25.6	17.6
	CU	6.21	-
	FE	81.3	60.6
	HG	-	-
	K	2080 T	2150 T
	MG	50000 GT	50000 GT
	MN	25	20.1
	NA	-	-
	NI	10.2	-
	PB	-	-
	SE	5.01	-
	V	-	-
	ZN	2900	2400
Anions	NIT	2200	2400
	CL	14000	42000
	SO4	390000	580000
	ALK	532000	488000
Indicator parameter	HAARD	910000	910000
	TDS	1140000	1370000
	pH(1)	6.0	7.0
	pH(2)	1239	1499
SpCond(2)		1206	1245
		1499	780
		1800	1800
		20000	20000
		34000	37000
		332000	376000
		432000	404000
		464000	443000
		7.4	7.3
		7.0	7.4
		1245	627

Notes and flagging codes are presented at the end of this table.



TABLE 7-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
DETERGENT BURNING GROUND/ EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
(3)	-	ELN-82-02C was resampled on 12/13/91 for TAL, Hardness, and NIT; original sample dated 12/9/91 was not preserved. Analytical results from both samples are reported in the IRDMIS, only the preserved results are reported in this table.
(4)	-	ELN-89-04A was resampled on 12/10/91 for TAL and hardness, original sample dated 12/5/91 was <u>not</u> filtered in the field. Analytical results from both samples are reported in the IRDMIS, only the filtered results are reported in this table.
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOCs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
.	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Annex K contains complete analytical results.

USA IHAMA chemical codes are defined in the RI Report Glossary



TABLE 7-15  
CHEMICAL AND PHYSICAL PROPERTIES OF MAJOR ORGANIC CONTAMINANTS -  
DETERRENT BURNING GROUND/EXISTING LANDFILL<sup>a</sup>

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICALS	CAS#	MOLECULAR WEIGHT (g/mole)	DENSITY	WATER SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm- m <sup>3</sup> /mole)	K <sub>ow</sub> <sup>b</sup> (ml/g)	K <sub>oc</sub> <sup>c</sup> (ml/ml)
<u>Volatile Organic Compounds</u>								
111TCE	71-55-6	133	1.32	1.50x10 <sup>3</sup>	123	1.44x10 <sup>-2</sup>	152	316
112TCE	79-00-5	133	1.32	4.50x10 <sup>3</sup>	19	7.42x10 <sup>-4</sup>	56	117
TRCLE	79-01-6	132	1.45	1.10x10 <sup>3</sup>	57.9	9.10x10 <sup>-3</sup>	126	240
C6H6	71-43-2	78	0.8786	1.75x10 <sup>3</sup>	95.2	5.58x10 <sup>-3</sup>	83	132
XYLEN	1330-20-7	106		1.98x10 <sup>2</sup>	10	7.04x10 <sup>-3</sup>	240	1.82x10 <sup>3</sup>
(ortho)	95-47-6	106	0.88	1.75x10 <sup>2</sup>	10			8.91x10 <sup>2</sup>
(meta)	106-38-3	106	0.864	1.30x10 <sup>2</sup>	10			1.82x10 <sup>3</sup>
(para)	106-42-3	106	0.86	1.98x10 <sup>2</sup>	10			1.41x10 <sup>3</sup>
<u>Semivolatiles</u>								
24DNT	121-14-2	182	1.32 (CRC)	2.40x10 <sup>2</sup>	5.10x10 <sup>-3</sup>	5.09x10 <sup>-6</sup>	45/250 (HO)	1.29x10 <sup>5</sup> 100
26DNT	606-20-2	182	1.28 (CRC)	1.32x10 <sup>3</sup>	1.80x10 <sup>-2</sup>	3.27x10 <sup>-6</sup>	92	100
NNDPA	86-30-6	198 <sup>1</sup>	1.23 (CRC)	1.13x10 <sup>2</sup>	6.3E-10 <sup>4</sup>	1.4x10 <sup>-6</sup>	650 (ADL)	1.35x10 <sup>3</sup> (ADL)

Notes:

<sup>a</sup> All data from the Risk Assessment Guidance for Superfund (USEPA, 1988a) unless otherwise noted: ADL = Arthur D. Little, 1985; CRC = CRC Handbook of Chemistry and Physics (Weast, 1980-81); and HO = Ho, 1988.

<sup>b</sup> K<sub>ow</sub> = partition coefficient between the organic chemical and carbon.

<sup>c</sup> K<sub>oc</sub> = partition coefficient of the chemical between octanol and water.

See List of USATHAMA Chemical Codes for definitions of chemical abbreviations.



TABLE 7-16  
ESTIMATES OF DISTANCES TRAVELED BY  
ORGANIC CONTAMINANTS IN GROUNDWATER  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Vc = V/[1 + Kd(b/n)] Kd = Koc* f oc: f oc is assumed to be 0.01							
Deterrent Burning Ground							
UPPER FLOW ZONE	CONTAMINANT VELOCITY Vc, Ft/Yr	PARTITION COEFFICIENT Kd, ml/g	Koc	SOIL DENSITY b, g/ml	SOIL POROSITY N=POROSITY	YEARS	DISTANCE, Ft.
Groundwater	20.0	NA	NA	2	0.3	40	800.0
111TCE	1.80	1.52	152	2	0.3	40	71.9
24DNT	5.0	0.45	45	2	0.3	40	200
24DNT	1.13	2.50	250	2	0.3	40	45.3
26DNT	2.80	0.92	92	2	0.3	40	112.1
NNDPA	0.45	6.50	650	2	0.3	40	18.0
LOWER FLOW							
ZONE	Vc, ft/yr	Kd, ml/g	Koc	b, g/ml	N=POROSITY	YEARS	DISTANCE, Ft.
Groundwater	150	NA	NA	2	0.3	40	6,000
111TCE	13.5	1.52	152	2	0.3	40	539
24DNT	37.5	0.45	45	2	0.3	40	1,500
24DNT	8.49	2.50	250	2	0.3	40	340
26DNT	21.0	0.92	92	2	0.3	40	841
NNDPA	3.38	6.50	650	2	0.3	40	135

**Notes:**

NA = not applicable  
ft/yr = feet per year  
ml/g = milliliters per gram  
g/ml = grams per milliliters

See list of USATHAMA Chemical Codes for definitions of chemical abbreviations



TABLE 7-17  
COMPOUNDS OF POTENTIAL CONCERN  
DETERRENT BURNING GROUND  
SUBSURFACE SOIL<sup>1</sup>

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	EXPOSURE POINT CONCENTRATION
	$\mu\text{g/g}$
24DNT	37,000
26DNT	1,400
3NT	6.9
AS	7.88
B2EHP	4.35
C6H6	5.25
CR	13.2
DNBP	62
FANT	0.139
MEC6H5	0.138
NI	10.2
NIT	18.7
NNDPA	2,200
PHANTH	0.183
PYR	0.144
SO4	5.19
TXYLEN	0.001
ZN	26.7

**Notes:**

Exposure point concentration is the maximum detected concentration.

$\mu\text{g/g}$  = milligrams per gram, equivalent to parts per million (ppm)

<sup>1</sup> Assessment of subsurface soil contamination (2 to 12 feet) was performed using samples from borings DBB-91-01 through DBB-91-03.



**TABLE 7-18**  
**SUMMARY OF RISK ESTIMATES**  
**DETERRENT BURNING GROUND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Future Construction Worker	Soil Ingestion	$1 \times 10^{-4}$	0.2
	Inhalation of Particulates	<u><math>4 \times 10^{-8}</math></u>	<u>0.000009</u>
	Total for Construction Worker	$1 \times 10^{-4}$	0.2



TABLE 7-19  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g/l}$   
DETERRENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
111TCE	8:80	12.1	3.07	200	200	200	40	-
112TCE	5:8	2.31	0.365	5	3	0.6	0.06	-
26DNT	2:80	2.17	1.29	-	-	0.05	0.005	-
BA	56:56	760	13.7	2,000	2,000	1,000(c)	200(c)	-
BE	10:80	1.14	0.362	-	-	-	-	0.02
CD	1:80	3.23	-	5	5	10(d)	1(d)	-
CL	80:80	69,000	1,450	250,000(a)	-	-	-	-
CR	38:80	140	4.98	100	100	50(e)	5(e)	-
CU	25:80	77.2	4.7	TT	1,300	-	-	-
HG	1:81	4.25	-	2	2	2	0.2	-
MN	21:56	480	7.85	50(a)	-	50(f)	25(f)	-
NA	38:56	33,000	2,890	20,000(b)	-	-	-	-
NIT	80:80	16,000	130	10,000	10,000	10,000	2,000	-
NNDPA	3:80	16.7	1.02	-	-	-	-	20
PB	4:80	8.61	5.94	TT	0	50(g)	5(g)	-
NI	8:80	24.4	9.45	100	100	-	-	-



continued

TABLE 7-19  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g}/\text{l}$   
DETERRENT BURNING GROUND/EXISTING LANDFILL

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
SE	2:80	5.01	4.03	50	50	10(h)	1(h)	
SO <sub>4</sub>	80:80	630,000	9,500	250,000(a)	-	250,000(f)	125,000(f)	
V	13:56	19.1	4.14	-	-	-	-	260
ZN	21:80	3,900	20.8	5,000(a)	-	5,000(f)	2,500(f)	7,300

Sources:

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards," Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations: Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of  $10^{-6}$  or HI of 1 (see Subsection 4.5 for details).

Notes:

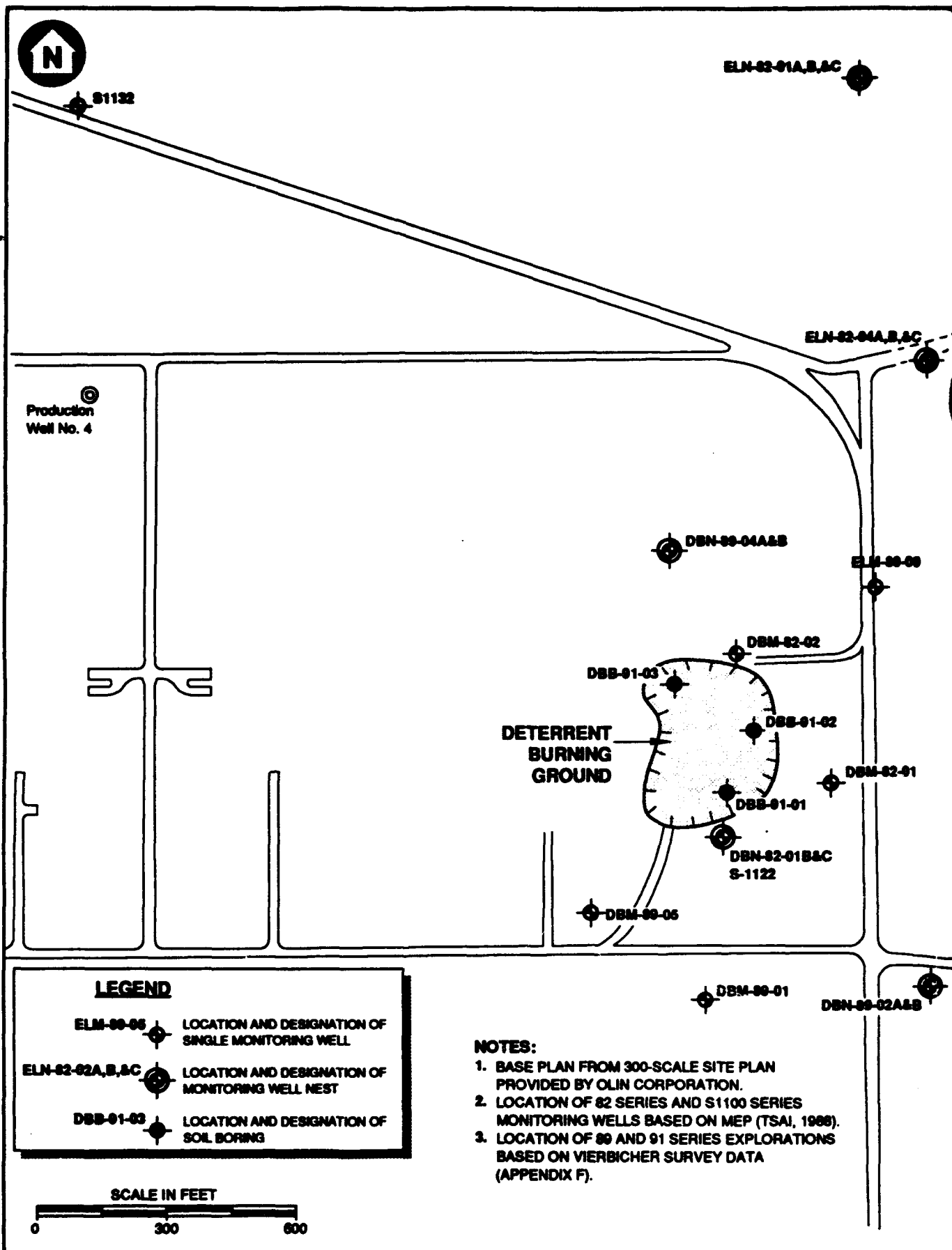
- (a) Secondary drinking water standard, suggested level.
- (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
- (c) WI proposing change to ES = 2,000  $\mu\text{g}/\text{l}$  and PAL = 400  $\mu\text{g}/\text{l}$
- (d) WI proposing change to ES = 5  $\mu\text{g}/\text{l}$  and PAL = 0.5  $\mu\text{g}/\text{l}$
- (e) WI proposing change to ES = 100  $\mu\text{g}/\text{l}$  and PAL = 10  $\mu\text{g}/\text{l}$
- (f) Value for protection of public welfare (usually aesthetic concerns) rather than for protection of human health
- (g) WI proposing change to ES = 15  $\mu\text{g}/\text{l}$  and PAL = 1.5  $\mu\text{g}/\text{l}$
- (h) WI proposing change to ES = 50  $\mu\text{g}/\text{l}$  and PAL = 10  $\mu\text{g}/\text{l}$

$\mu\text{g}/\text{l}$	=	micrograms per liter	TT	=	Treatment technique requirement in effect Copper action level - 1,300 $\mu\text{g}/\text{l}$ Lead action level - 15 $\mu\text{g}/\text{l}$
SDWA	=	Safe Drinking Water Act			
MCL	=	Maximum Contaminant Level			
MCLG	=	Maximum Contaminant Level Goal			
WI	=	Wisconsin			
ES	=	Enforcement Standard			
PAL	=	Preventive Action Limit			

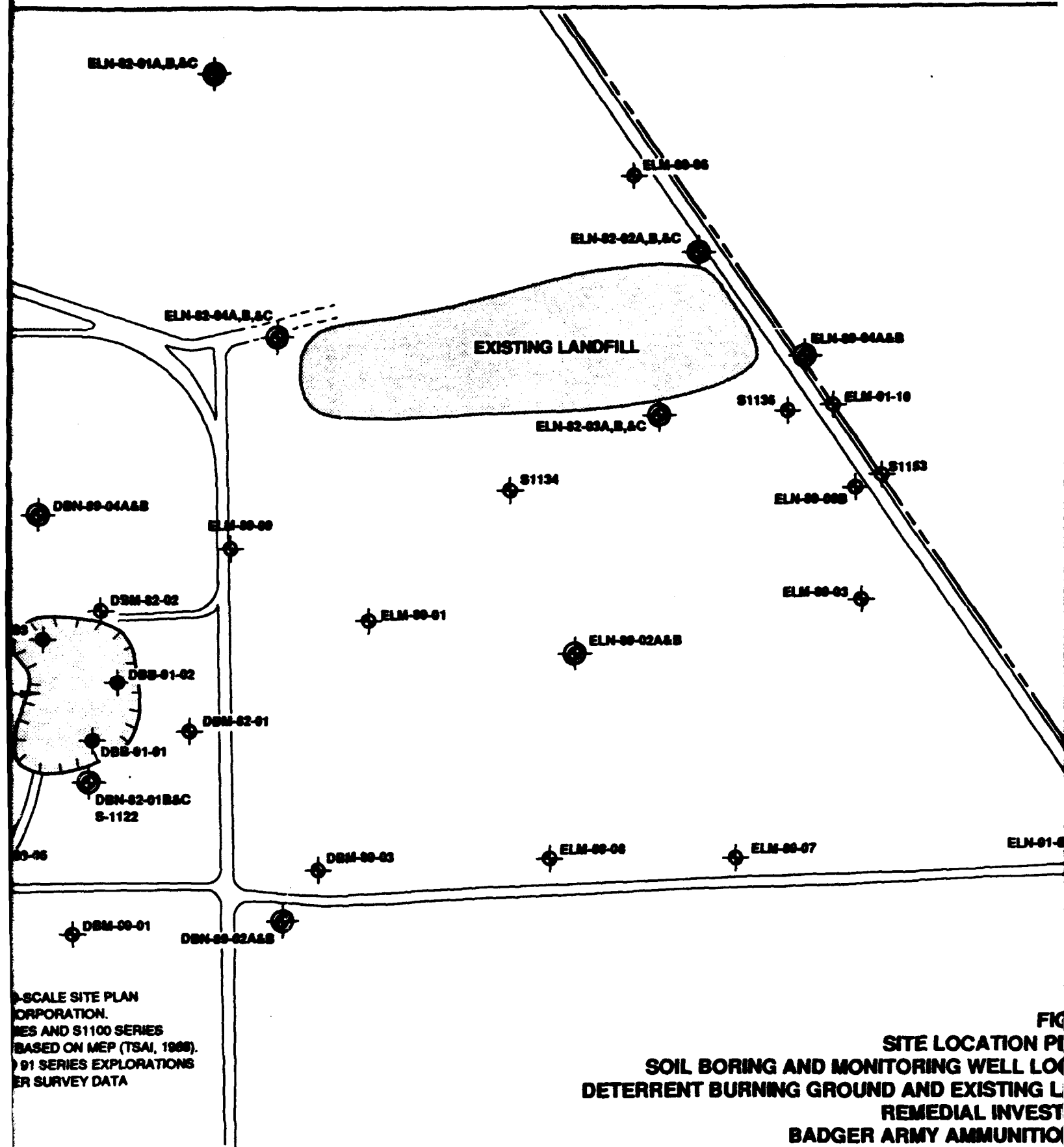


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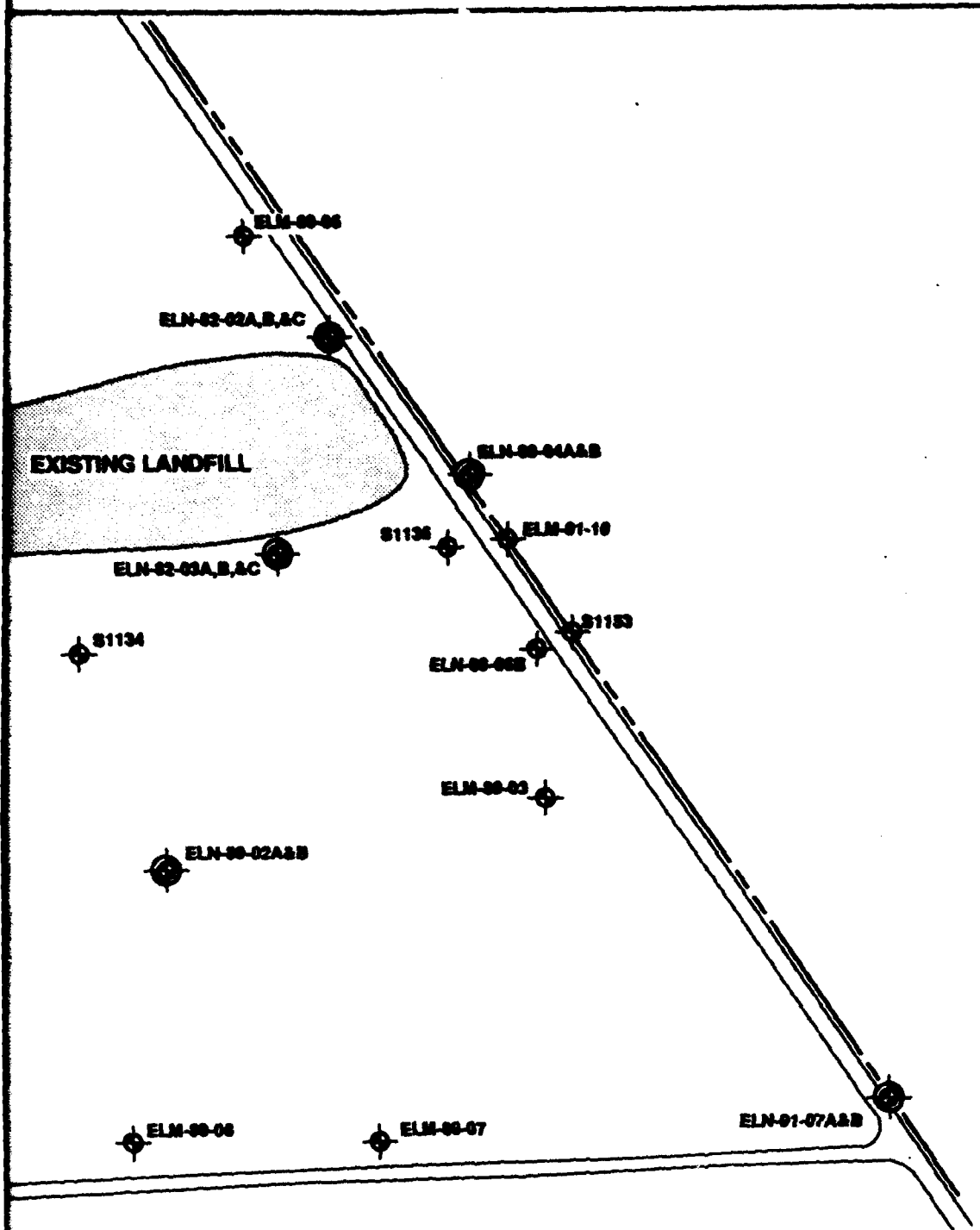








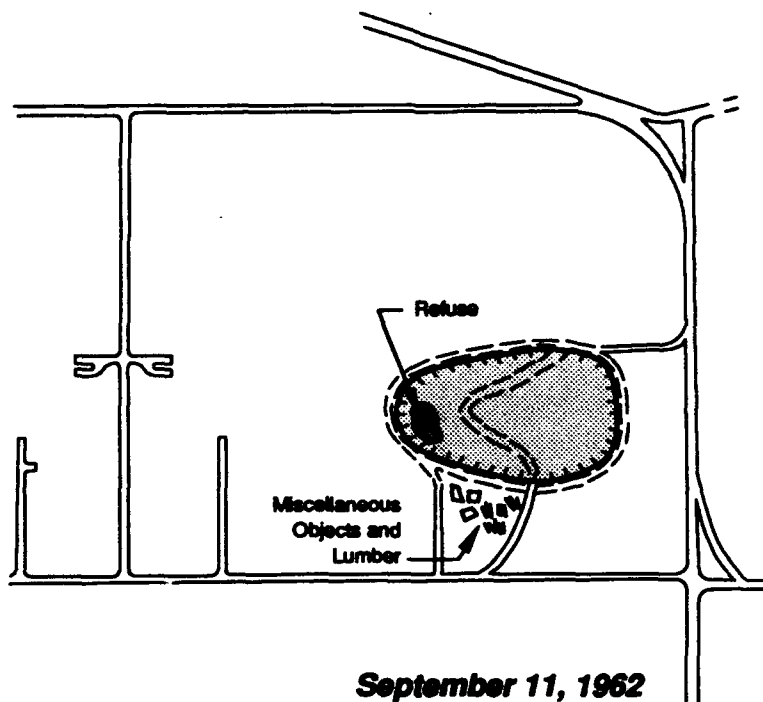
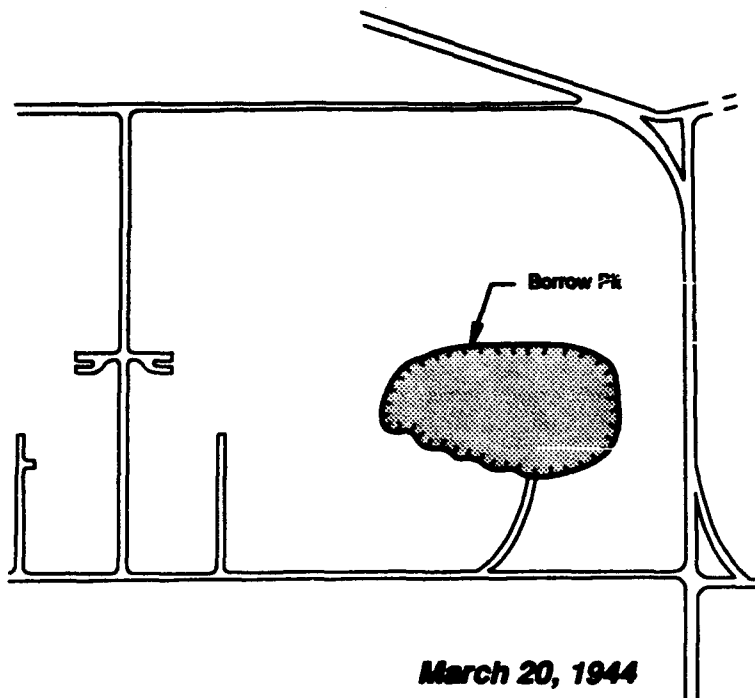




**FIGURE 7-1**  
**SITE LOCATION PLAN AND**  
**SOIL BORING AND MONITORING WELL LOCATIONS**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





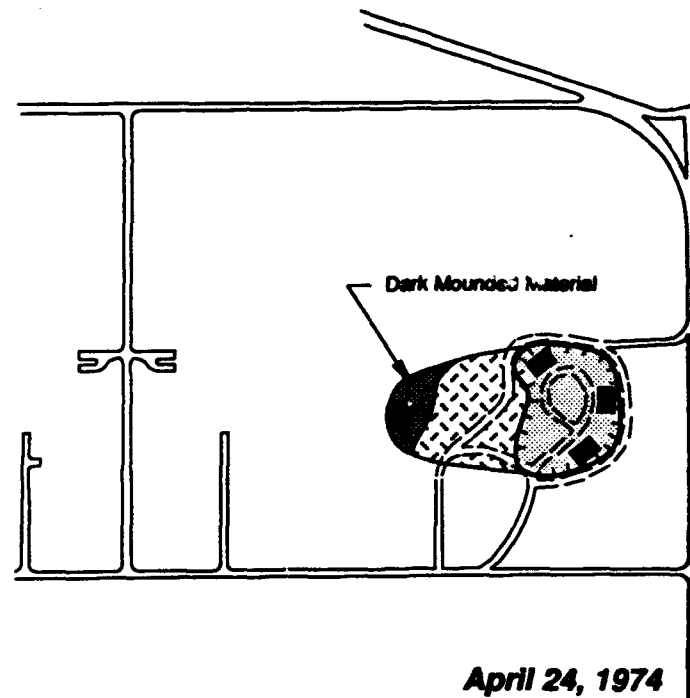
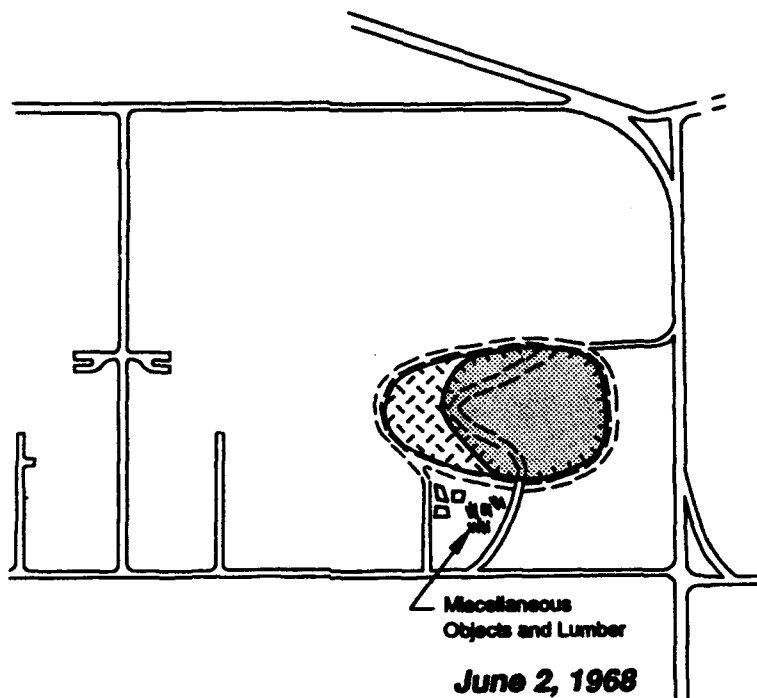
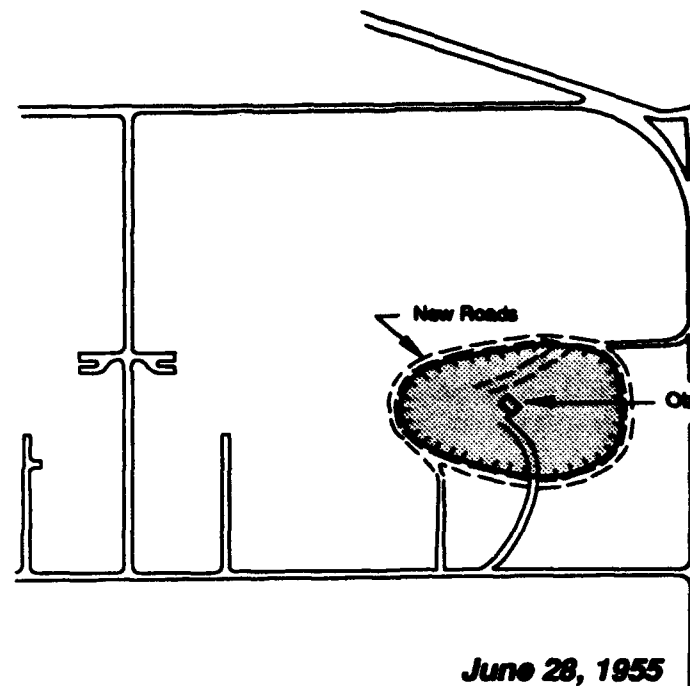
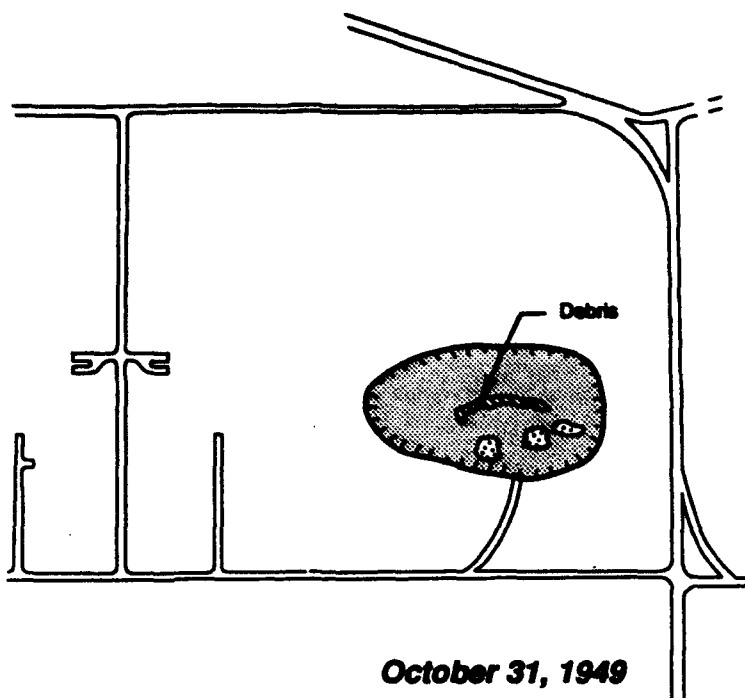
#### LEGEND

- TOP EDGE OF SLOPE
- AREA OF ACTIVITY
- ACCESS ROAD
- MOUNDED MATERIAL
- FILLED AREA
- INTERPRETED DETERRENT BURNING PIT

#### NOTES:

1. BASE PLAN FROM 300 SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. CHRONOLOGICAL EVOLUTION BASED ON AIR-PHOTO INTERPRETATION. SEE SECTION 7.1.

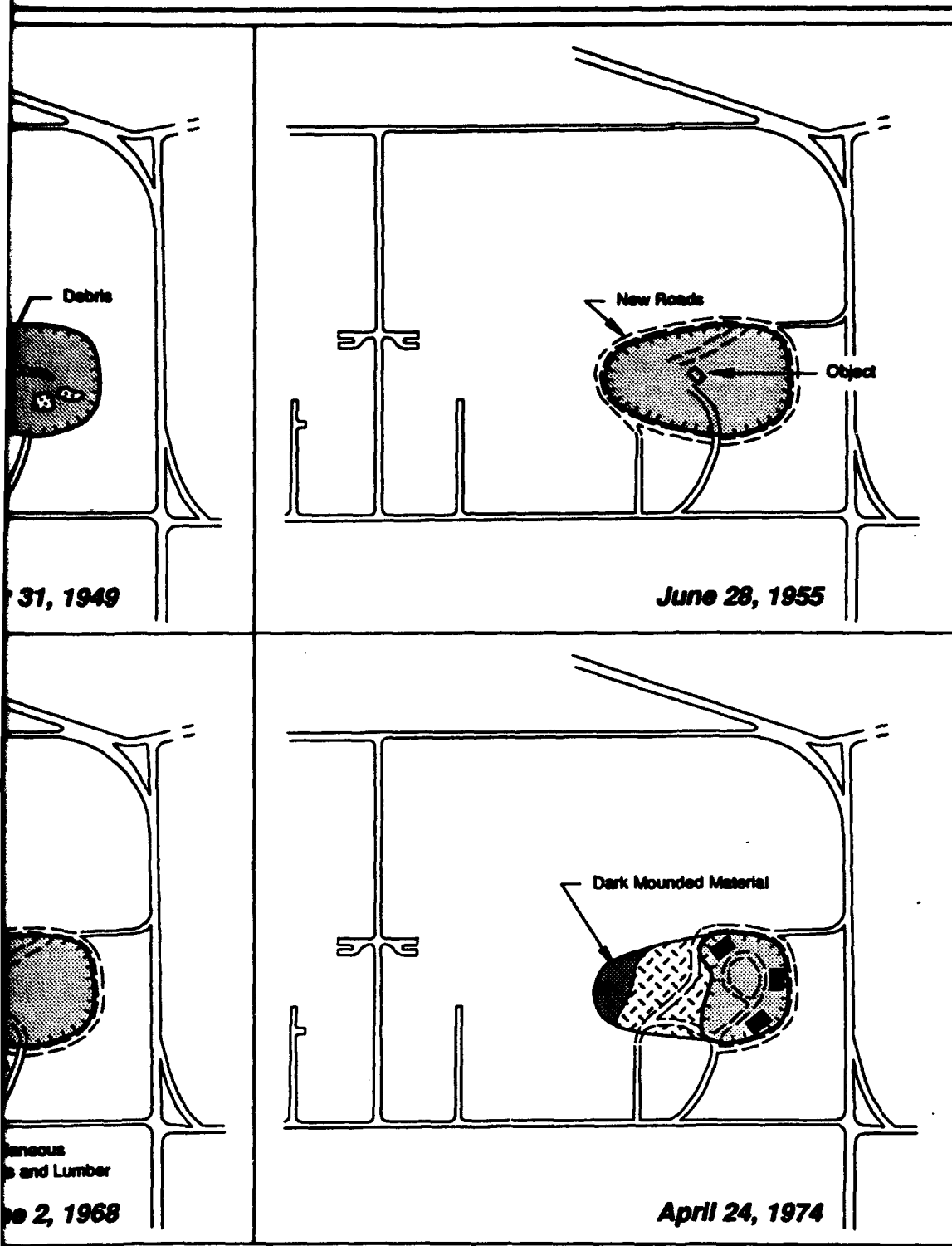




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BADGER ARMY AMMUNITION  
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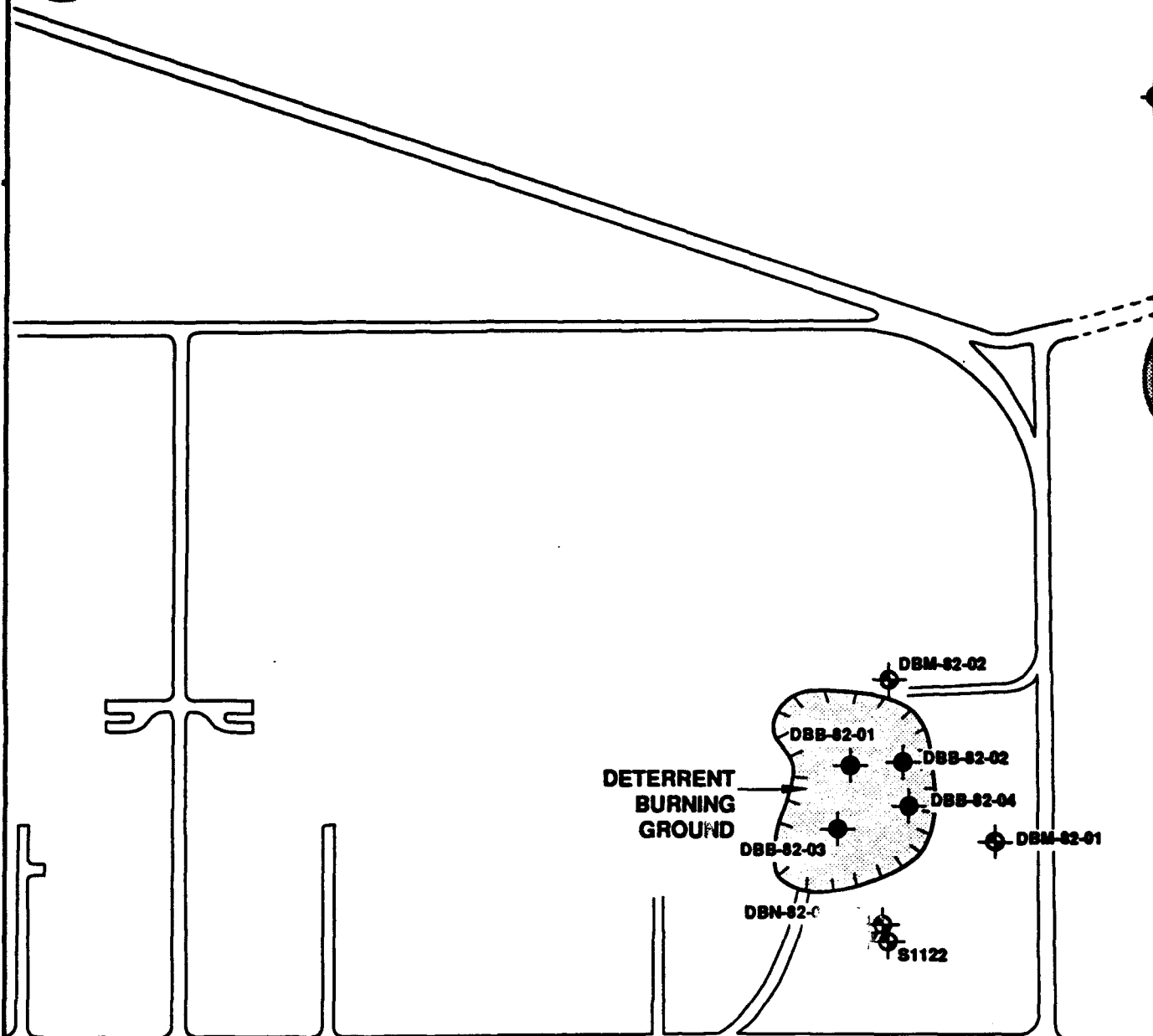


**FIGURE 7-2**  
**CHRONOLOGICAL EVOLUTION OF**  
**THE DETERRENT BURNING GROUND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.





ELB-82-01



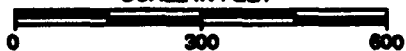
### LEGEND

- DBM-82-01  LOCATION AND DESIGNATION OF EXISTING MONITORING WELL
- DBB-82-01  LOCATION AND DESIGNATION OF EXISTING SOIL BORING

### NOTES:

1. BASE PLAN FROM 300-SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. LOCATION OF BORINGS AND MONITORING WELLS FROM MEP (TSAI, 1988).

SCALE IN FEET





2

ELB-82-01

ELB-82-02  
200 FEET NORTH

ELB-82-03

ELB-82-04

ELB-82-05

EXISTING LANDFILL

ELB-82-06

DBM-82-02

DBB-82-01

DBB-82-02

DBB-82-04

DBB-82-03

DBM-82-01

DBB-82-01B,C

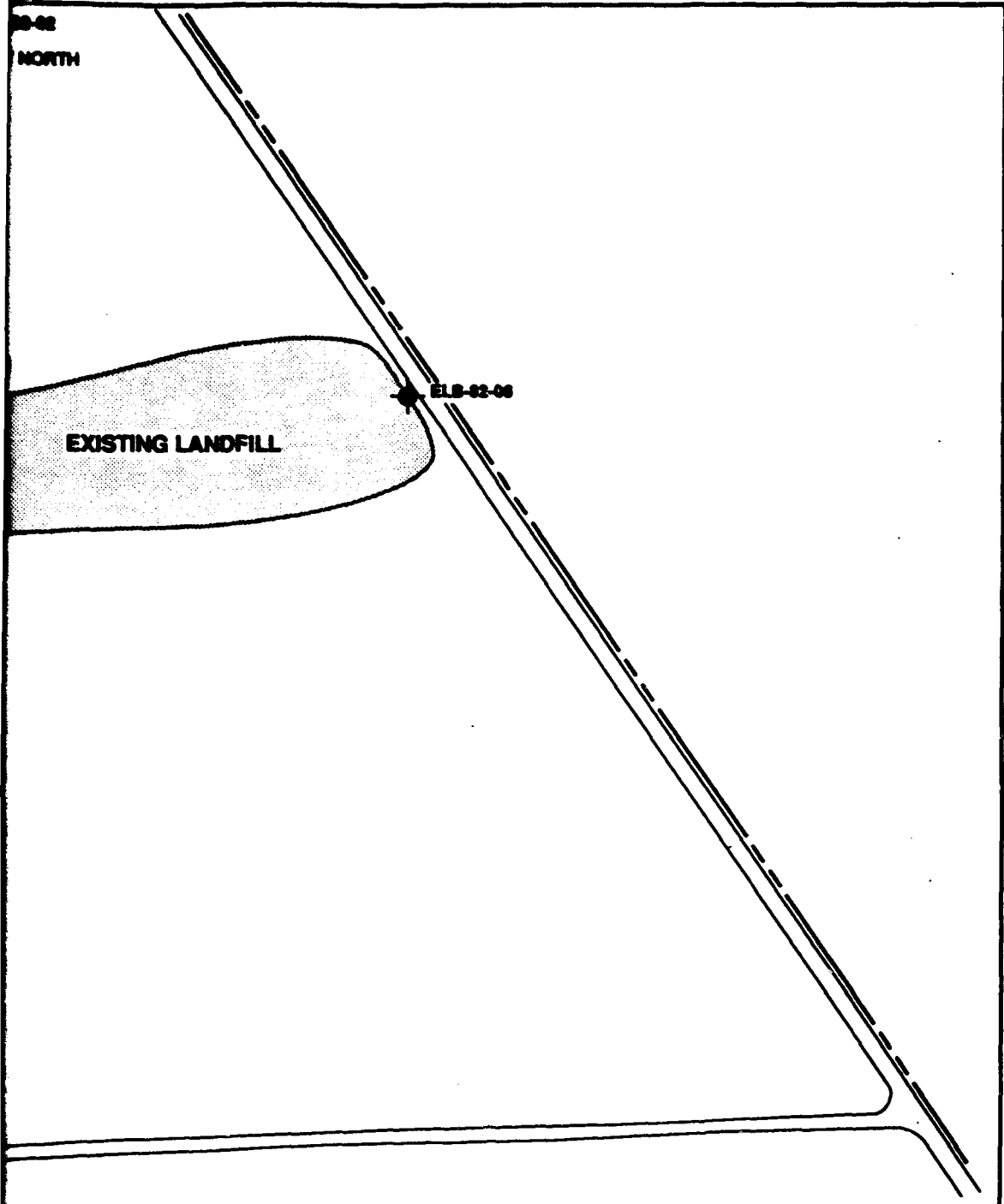
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GS AND MONITORING  
SAI, 1988).

FK  
LOCATION OF PREVIOUS EXPLO  
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BADGER ARMY AMMUNITION

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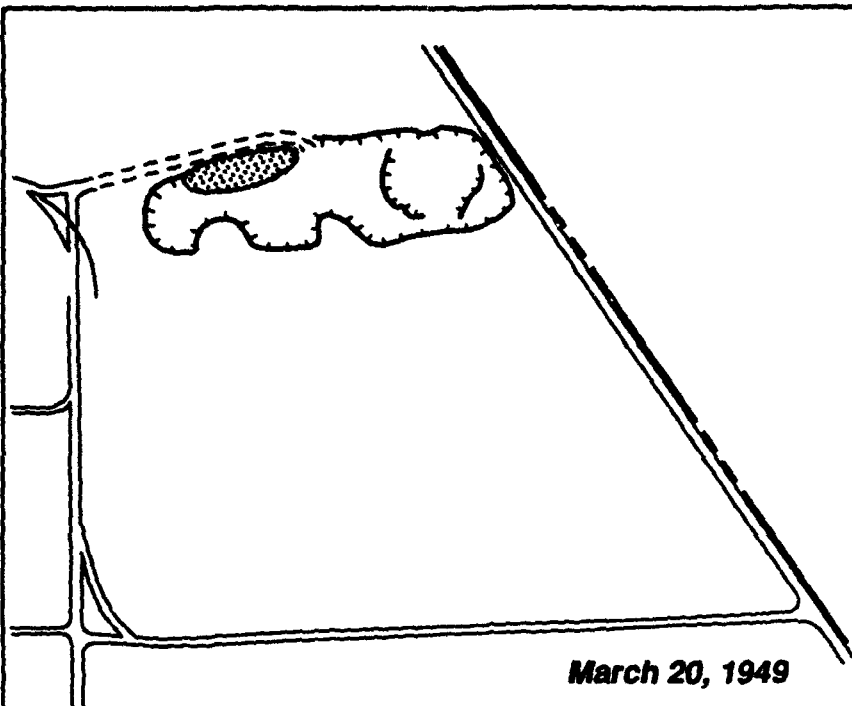




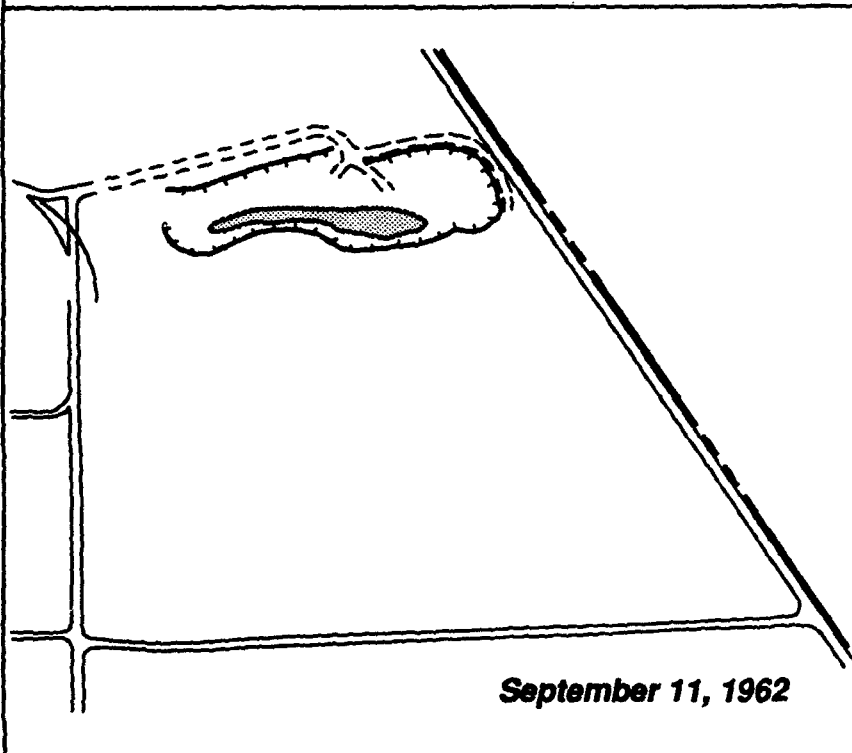
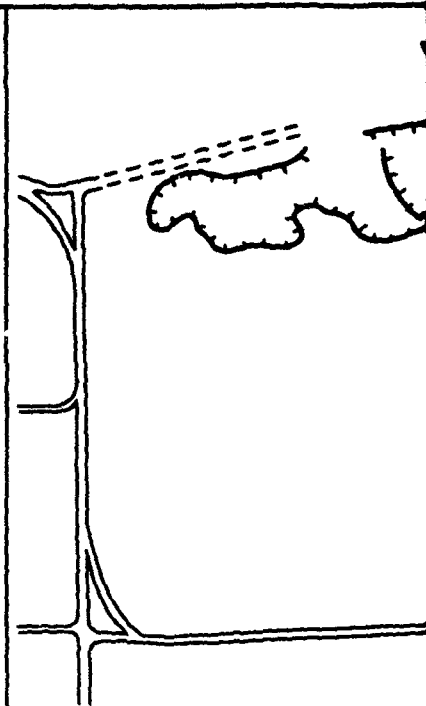
**FIGURE 7-3**  
**LOCATION OF PREVIOUS EXPLORATIONS**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

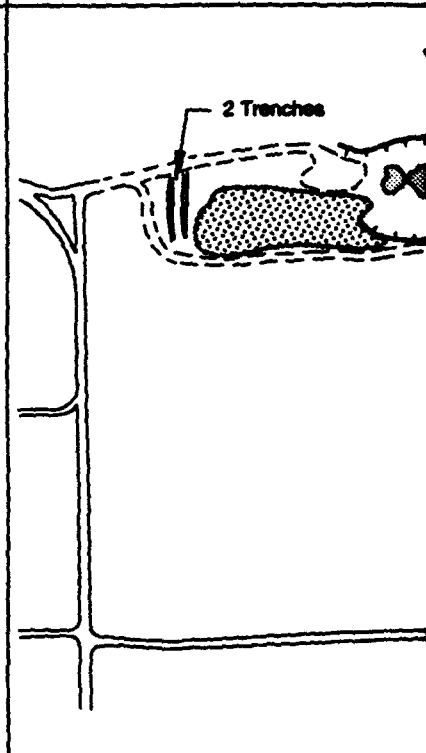




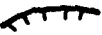
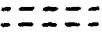


March 20, 1949



September 11, 1962



**LEGEND**

-  TOP EDGE OF SLOPE
-  ACCESS ROAD
-  MOUNDED MATERIAL
-  REFUSE

**NOTES:**

1. BASE PLAN FROM 300 SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. CHRONOLOGICAL EVOLUTION BASED ON AIR-PHOTO INTERPRETATION. SEE SECTION 7.1.



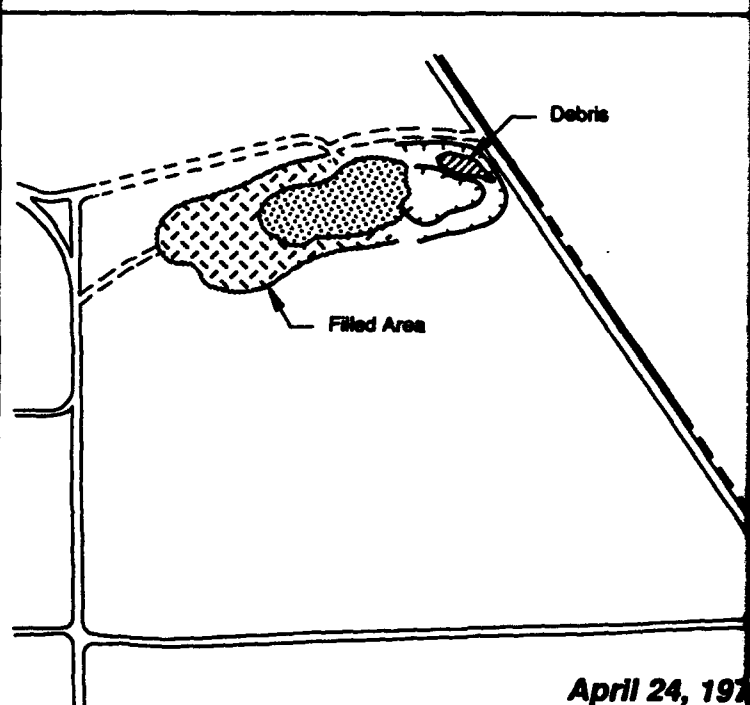
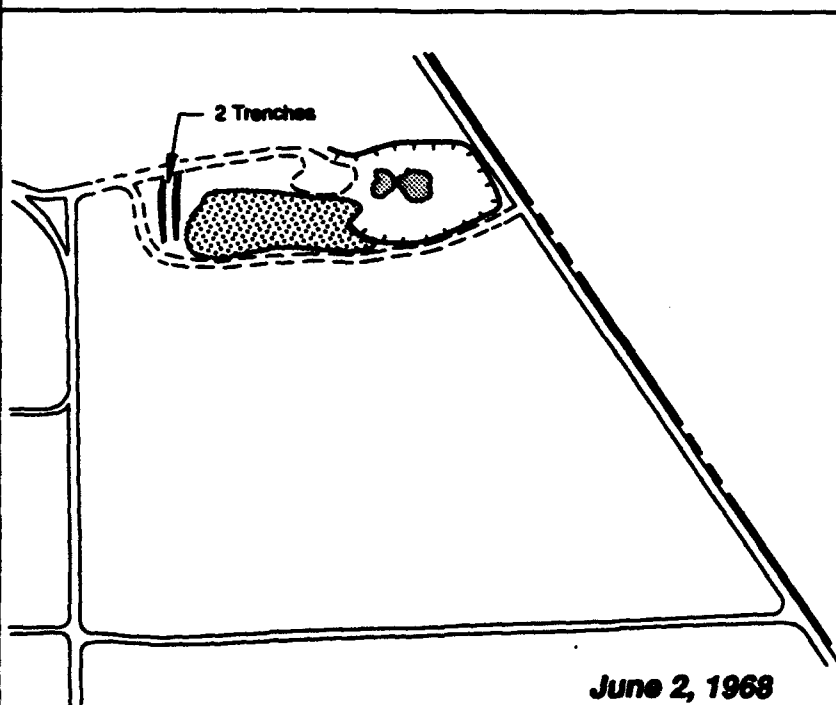
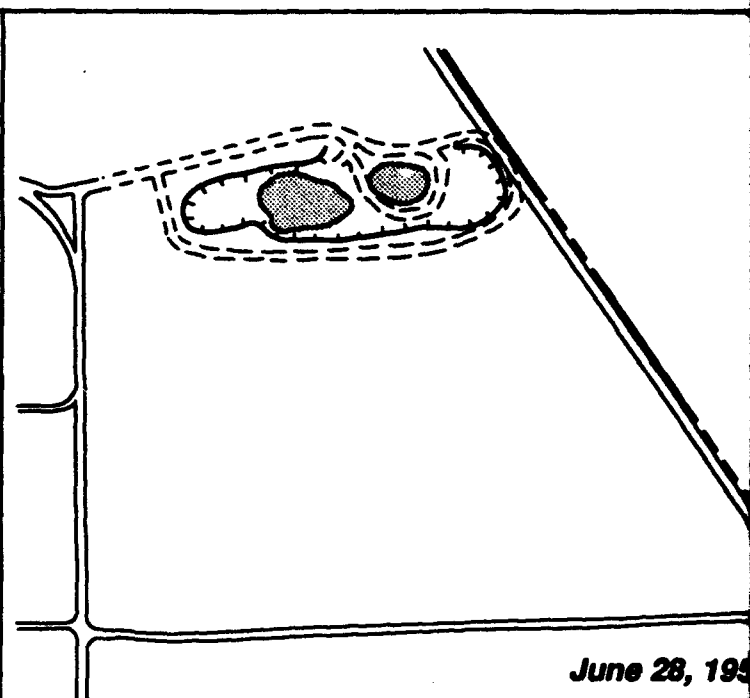
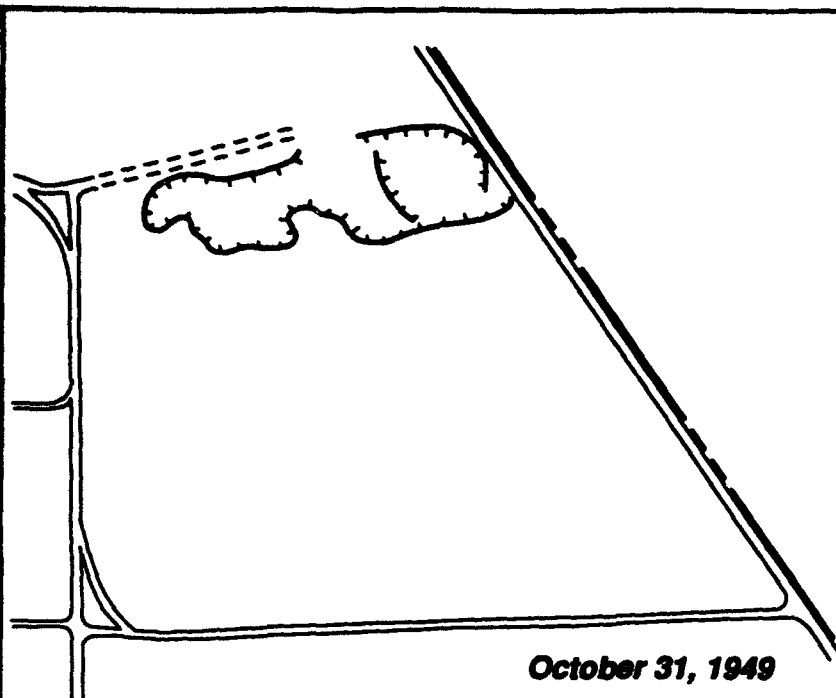
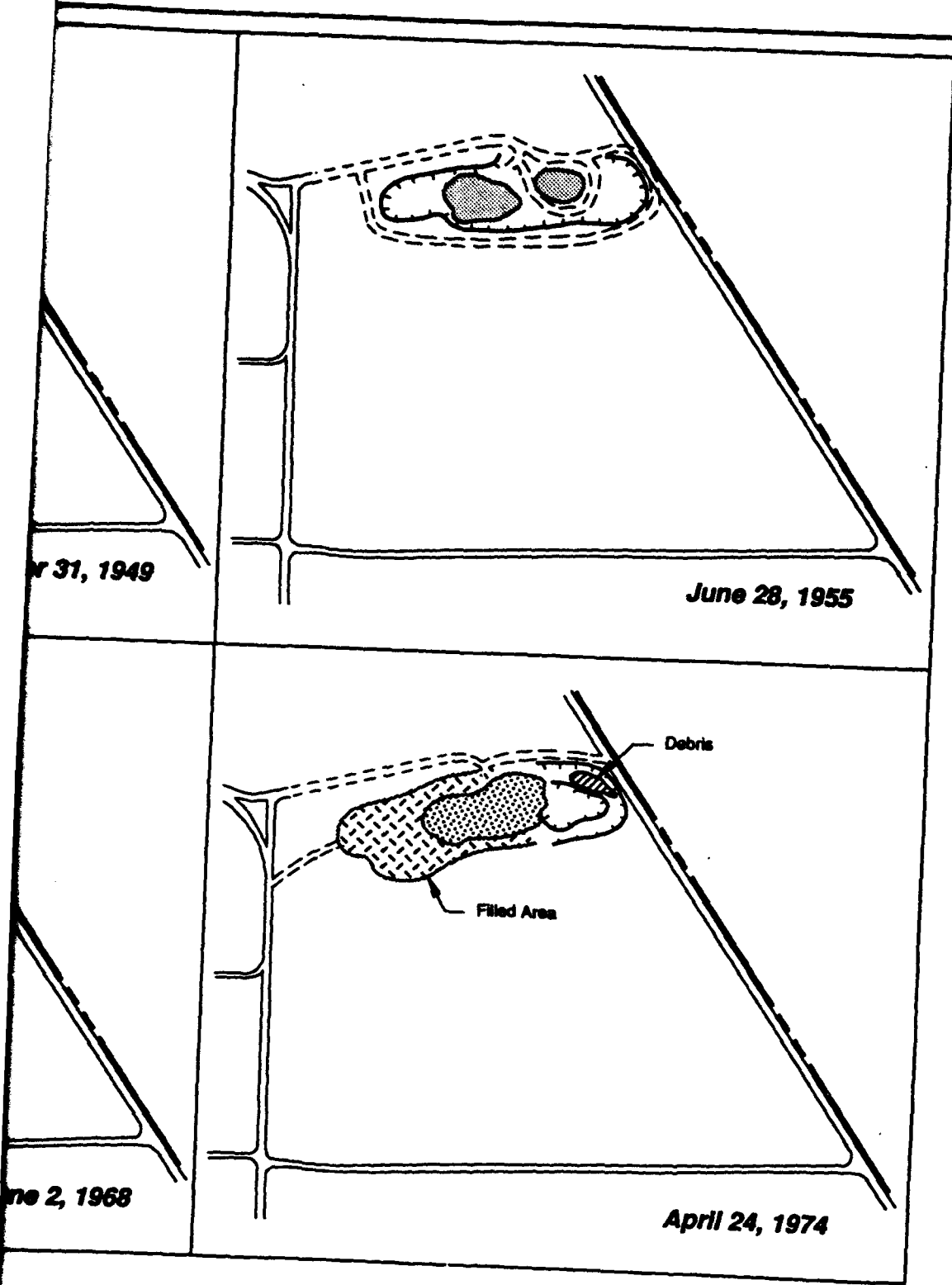


FIGURE 1  
CHRONOLOGICAL EVOLUTION OF THE EXISTING LAND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental Services

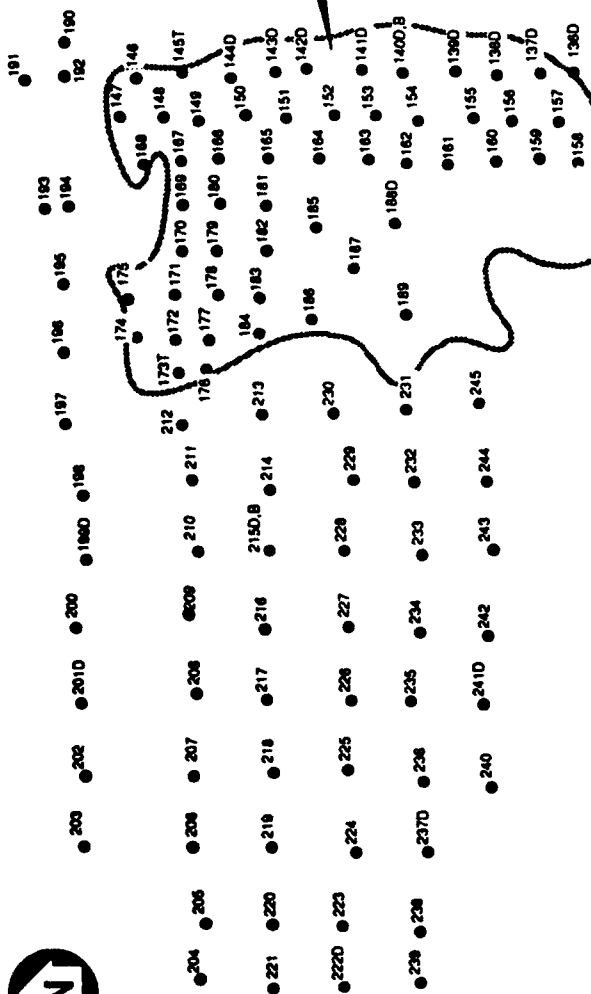




**FIGURE 7-4**  
**CHRONOLOGICAL EVOLUTION OF THE EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





DETERRENT  
BURNING  
GROUND

**LEGEND**

— OUTLINE OF EXISTING DETERRENT  
BURNING GROUND DEPRESSION

T - TIME CALIBRATION COLLECTOR LOCATION

B - BLANK COLLECTOR LOCATION

D - DUPLICATE COLLECTOR LOCATION

**NOTES:**

1. BASE MAP FROM 300 SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. SOIL GAS SAMPLE POINTS LOCATED BY NERI (SEE APPENDIX B).

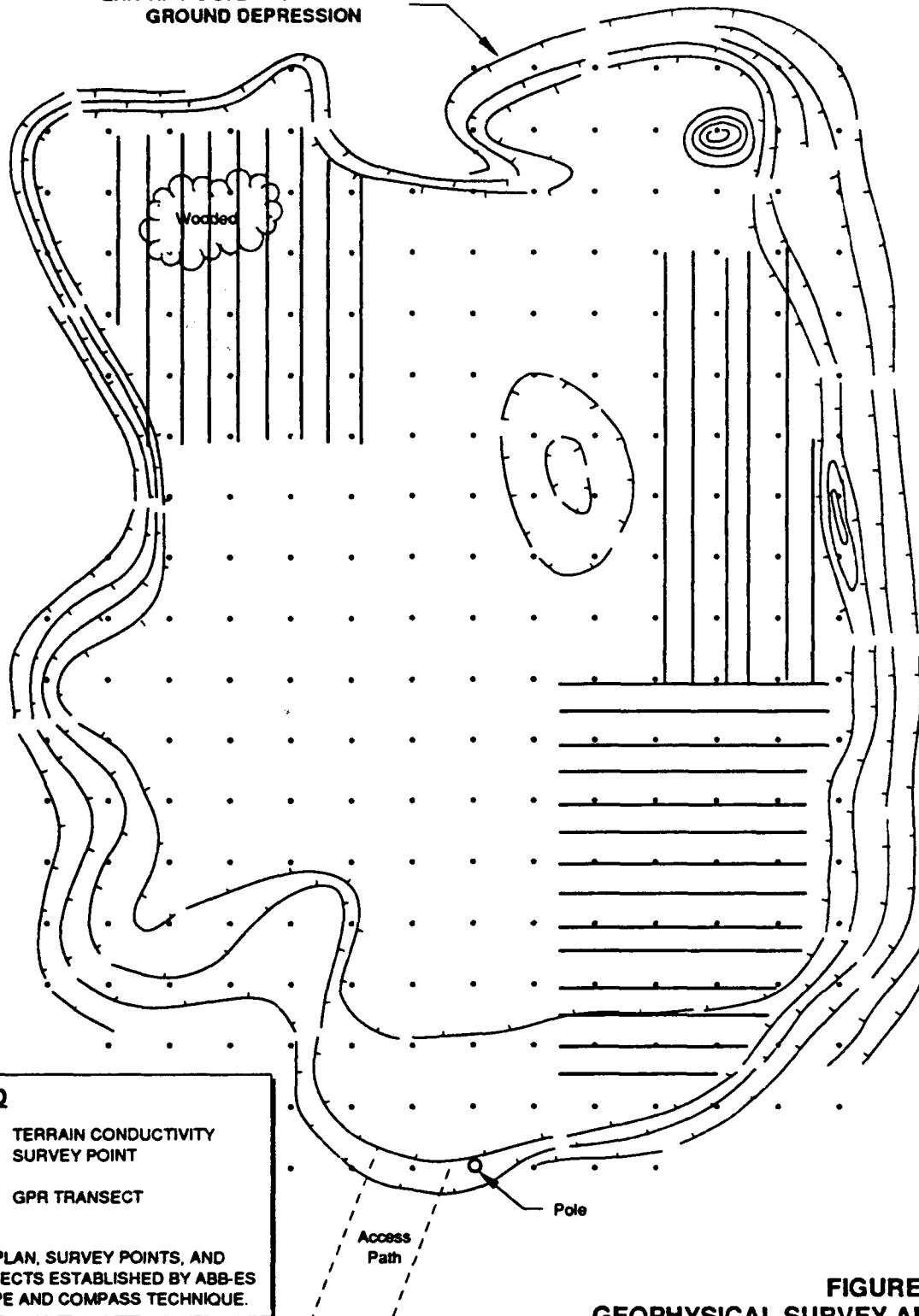


**FIGURE 7-5**  
**PETREX SOIL GAS SAMPLE LOCATIONS**  
**DETERRENT BURNING GROUND**  
**BADGER ARMY AMMUNITION PLANT**  
ABB Environmental Services, Inc.





EXISTING DETERRENT BURNING  
GROUND DEPRESSION



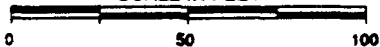
**LEGEND**

- • TERRAIN CONDUCTIVITY  
SURVEY POINT
- GPR TRANSECT

**NOTES:**

1. BASE PLAN, SURVEY POINTS, AND  
TRANSECTS ESTABLISHED BY ABB-ES  
BY TAPE AND COMPASS TECHNIQUE.

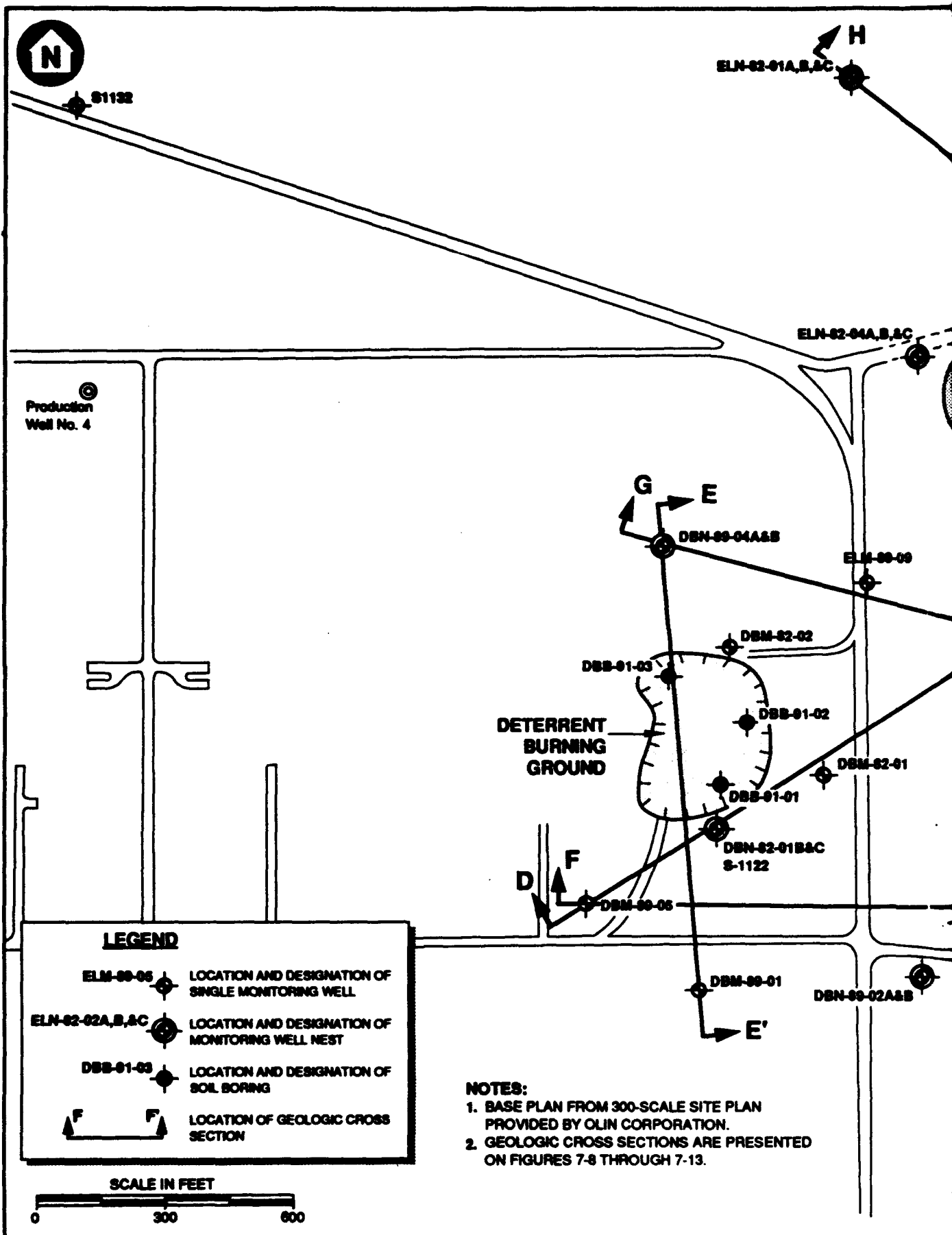
SCALE IN FEET



**FIGURE 7-6**  
**GEOPHYSICAL SURVEY AREA**  
**DETERRENT BURNING GROUND**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.







**AL SITE PLAN  
ORATION.  
IONS ARE PRESENTED  
H 7-13.**

**LOCATION AND ORIENTATION OF G  
CROSS S  
DETERRENT BURNING GROUND AND EXISTING L  
REMEDIAL INVEST  
BADGER ARMY AMMUNITION  
ABB Environmental S**

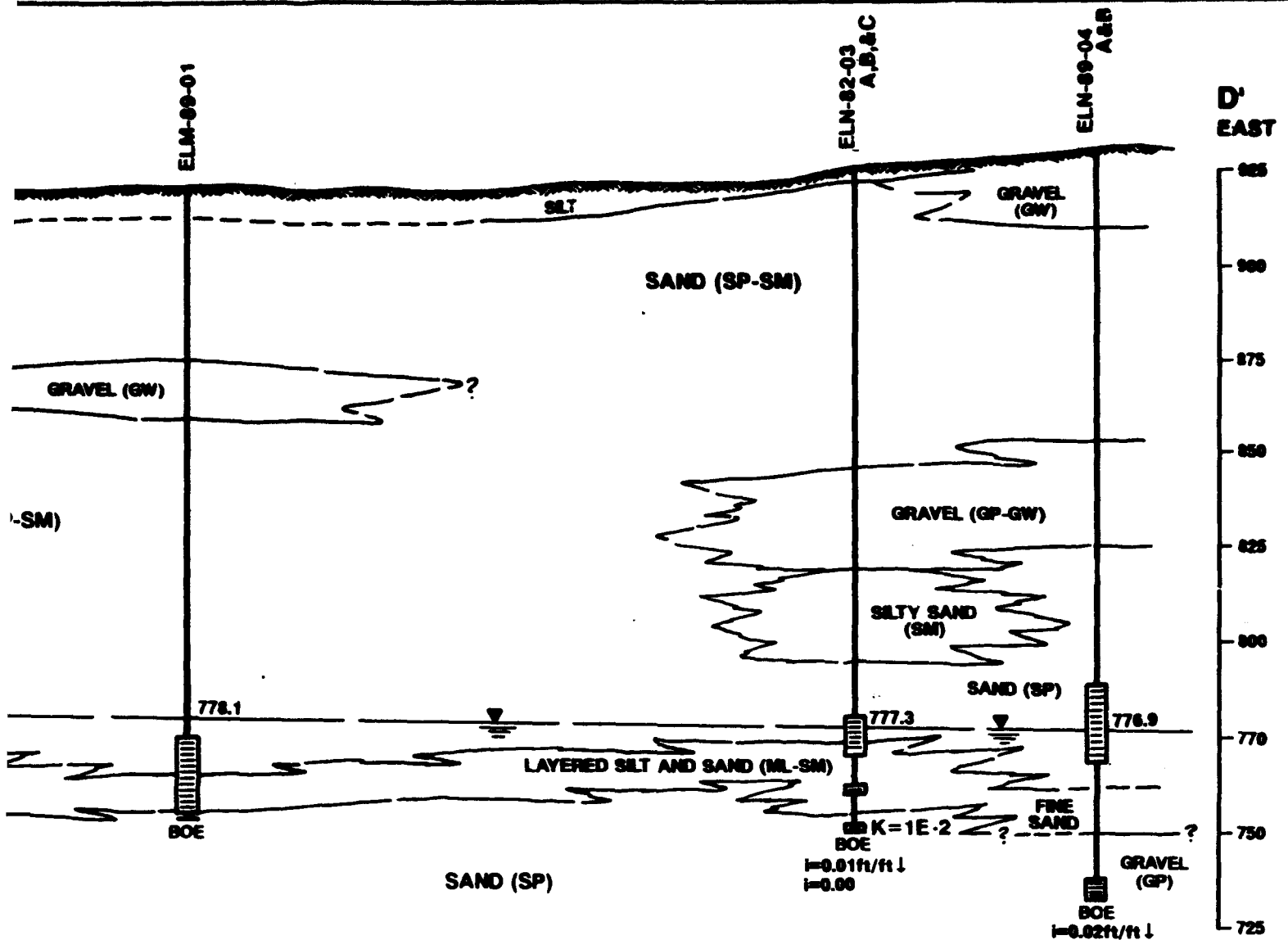






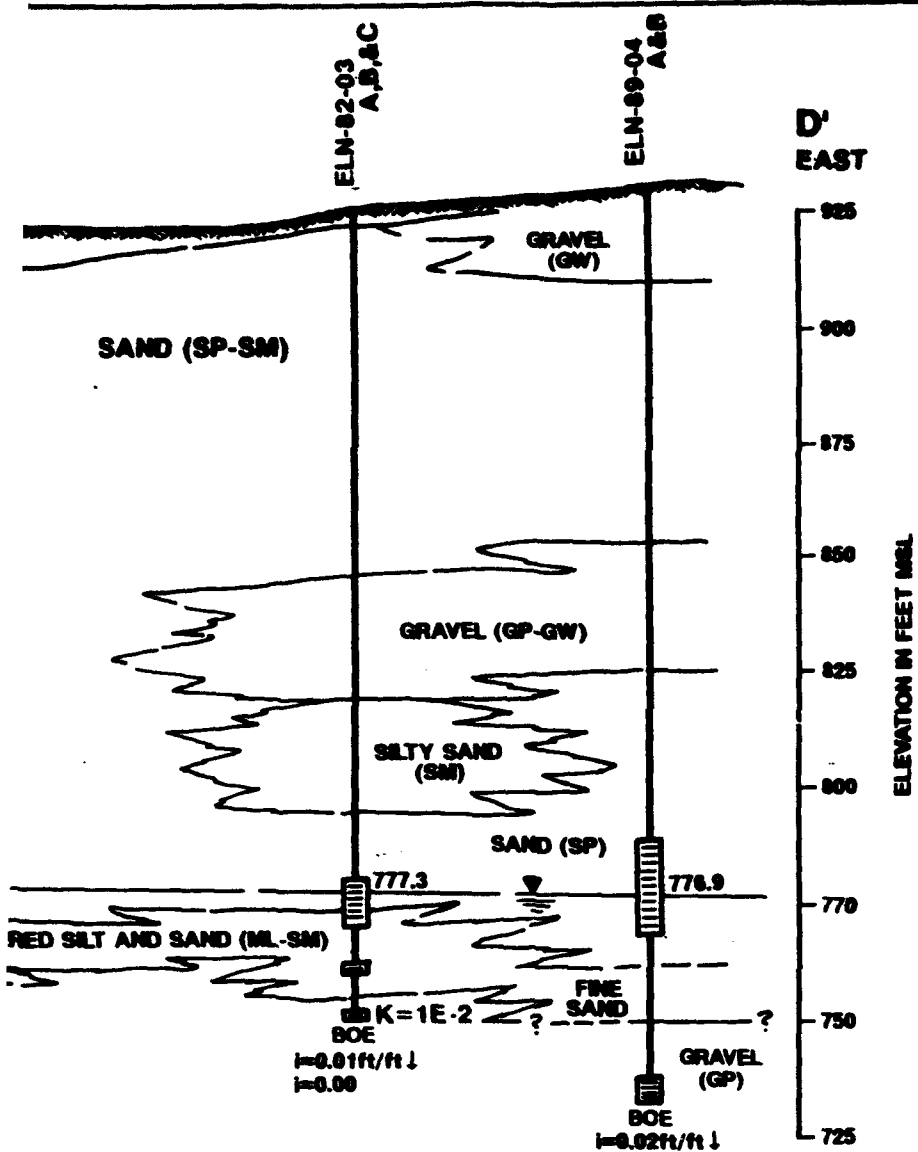






GEOLOGIC CROSS SECTION  
DETERRENT BURNING GROUND AND EXISTING  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental

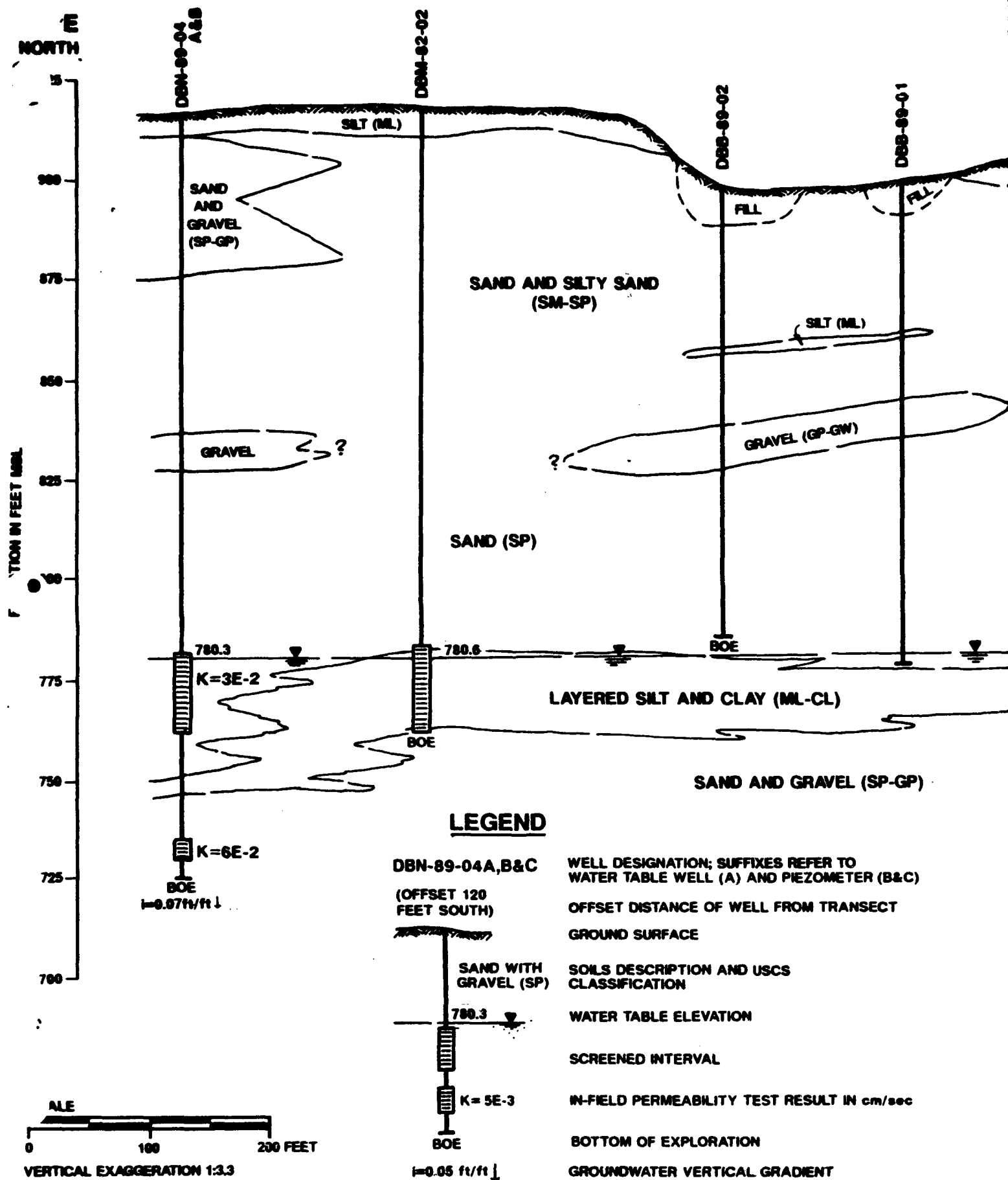




**FIGURE 7-8**  
**GEOLOGIC CROSS SECTION D-D'**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

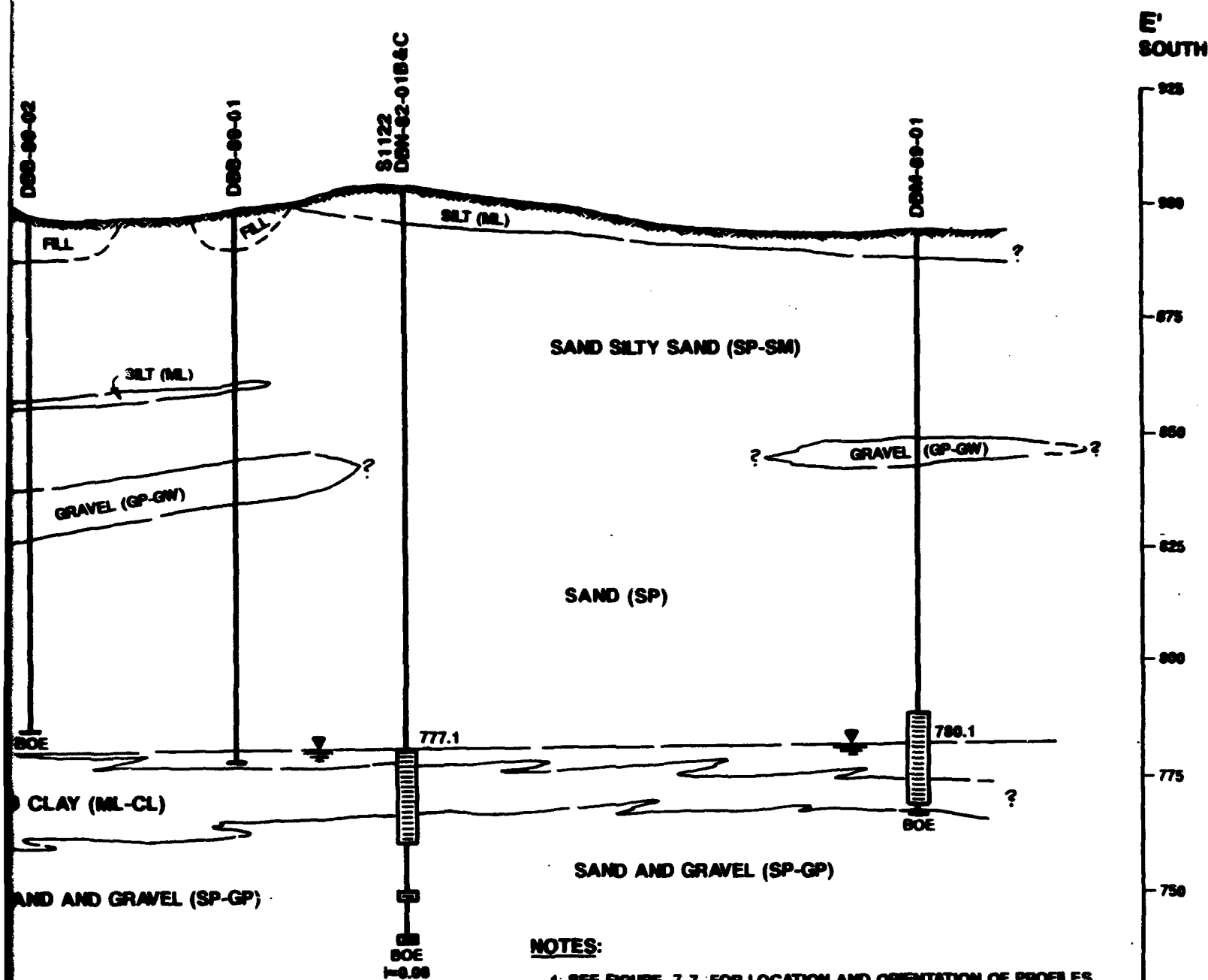
ABB Environmental Services, Inc.







2

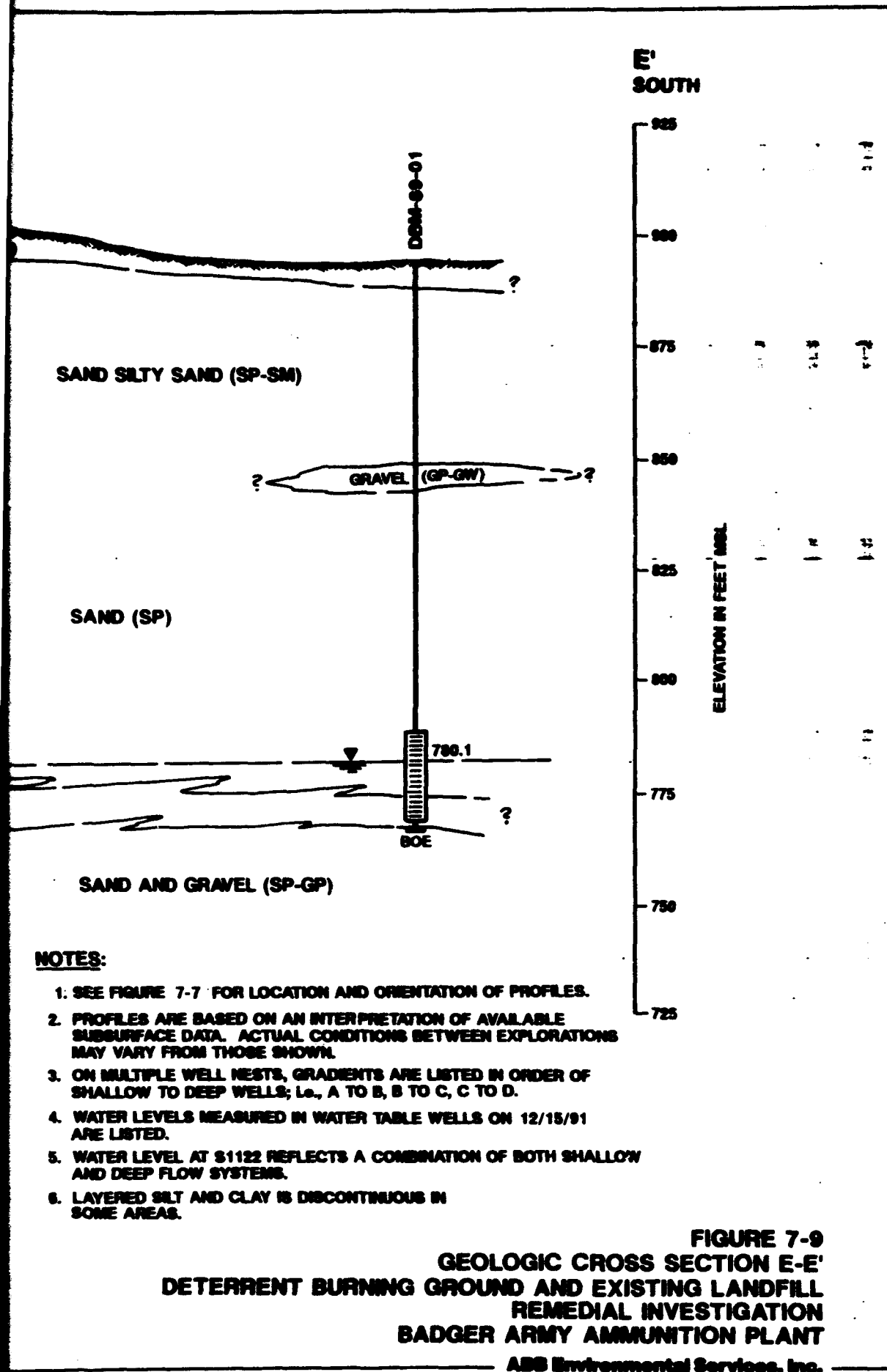


**NOTES:**

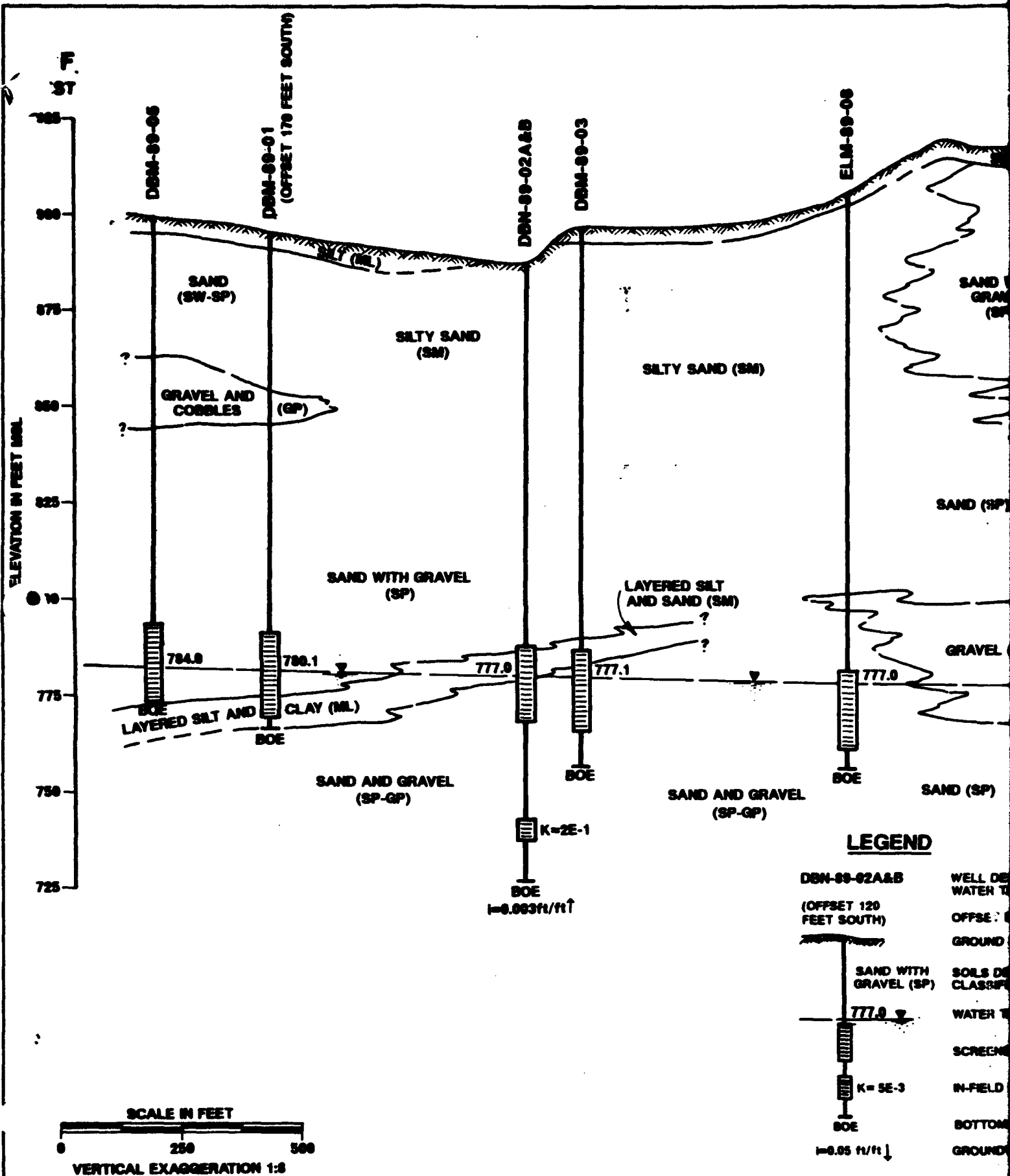
1. SEE FIGURE 7-7 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. ON MULTIPLE WELL NESTS, GRADIENTS ARE LISTED IN ORDER OF SHALLOW TO DEEP WELLS; I.e., A TO B, B TO C, C TO D.
4. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
5. WATER LEVEL AT S1122 REFLECTS A COMBINATION OF BOTH SHALLOW AND DEEP FLOW SYSTEMS.
6. LAYERED SILT AND CLAY IS DISCONTINUOUS IN SOME AREAS.

**GEOLOGIC CROSS SECTION**  
**DETERRENT BURNING GROUND AND EXISTING**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**  
**ABS Environmental Services**





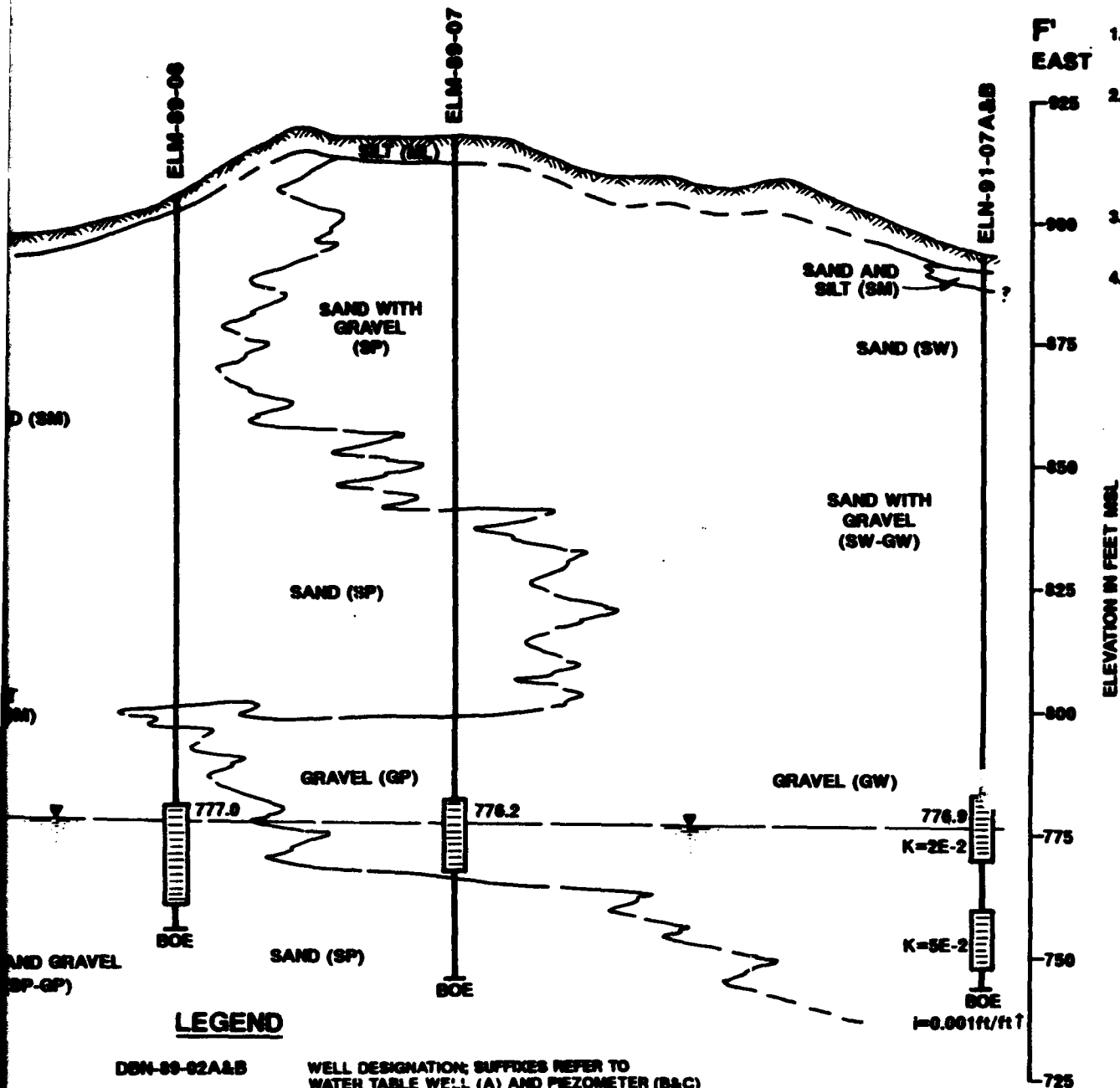






## NOTES:

1. SEE FIGURE 7-7 FOR LOCATION ORIENTATION OF PROFILE
2. PROFILES ARE BASED ON INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACT BETWEEN EXPLORATIONS THOSE SHOWN.
3. WATER LEVELS MEASURED TABLE WELLS ON 12/16/91
4. LAYERED SILT AND CLAY SAND AND BECOMES DISCONTINUOUS EAST OF DBN-99-02B.



## LEGEND

DBN-99-02A&amp;B

(OFFSET 120  
FEET SOUTH)

GROUND SURFACE

SAND WITH  
GRAVEL (SP)

777.9

SCREENED INTERVAL

K=5E-3

BOE

0.05 ft/ft

WELL DESIGNATION; SUFFIXES REFER TO  
WATER TABLE WELL (A) AND PIEZOMETER (B&C)

OFFSET DISTANCE OF WELL FROM TRANSECT

GROUND SURFACE

SOILS DESCRIPTION AND USCS  
CLASSIFICATION

WATER TABLE ELEVATION

SCREENED INTERVAL

IN-FIELD PERMEABILITY TEST RESULT IN cm/sec

BOTTOM OF EXPLORATION

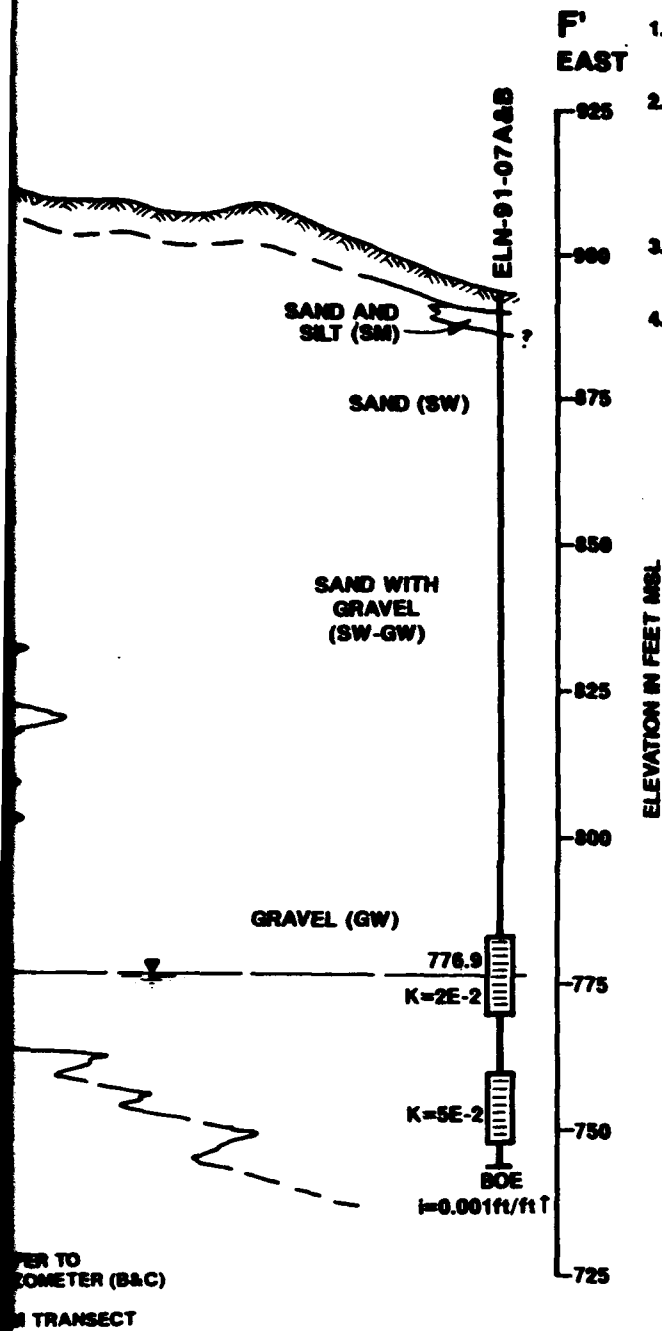
GROUNDWATER VERTICAL GRADIENT

FIGURE 7-7  
GEOLOGIC CROSS SECTION  
DETERRENT BURNING GROUND AND EXISTING LATERAL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
A&B Environmental Services



**NOTES:**

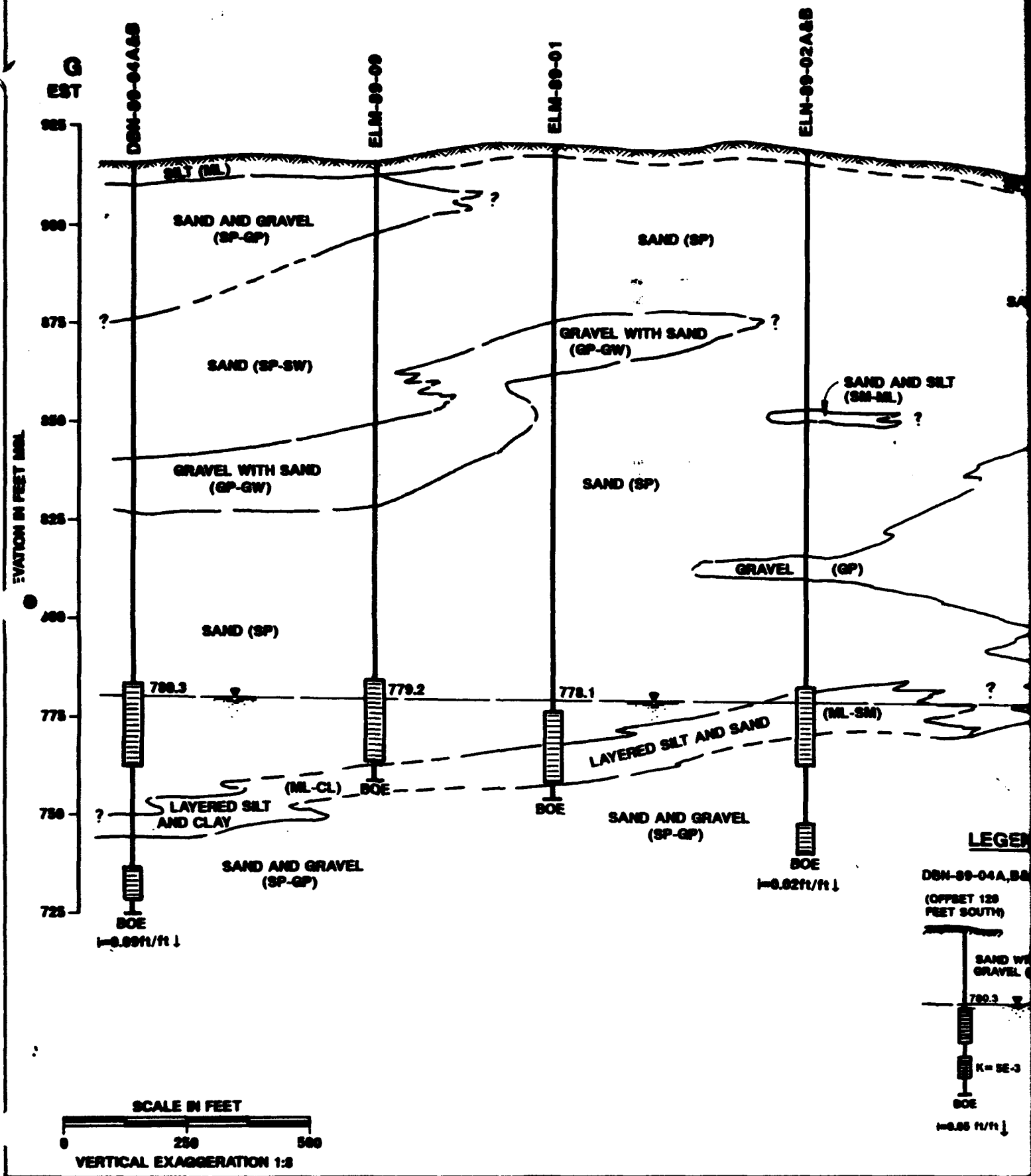
1. SEE FIGURE 7-7 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
4. LAYERED SILT AND CLAY GRADES TO SILTY SAND AND BECOMES DISCONTINUOUS EAST OF DSN-88-02B.



**FIGURE 7-10**  
**GEOLOGIC CROSS SECTION F-F'**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABS Environmental Services, Inc.

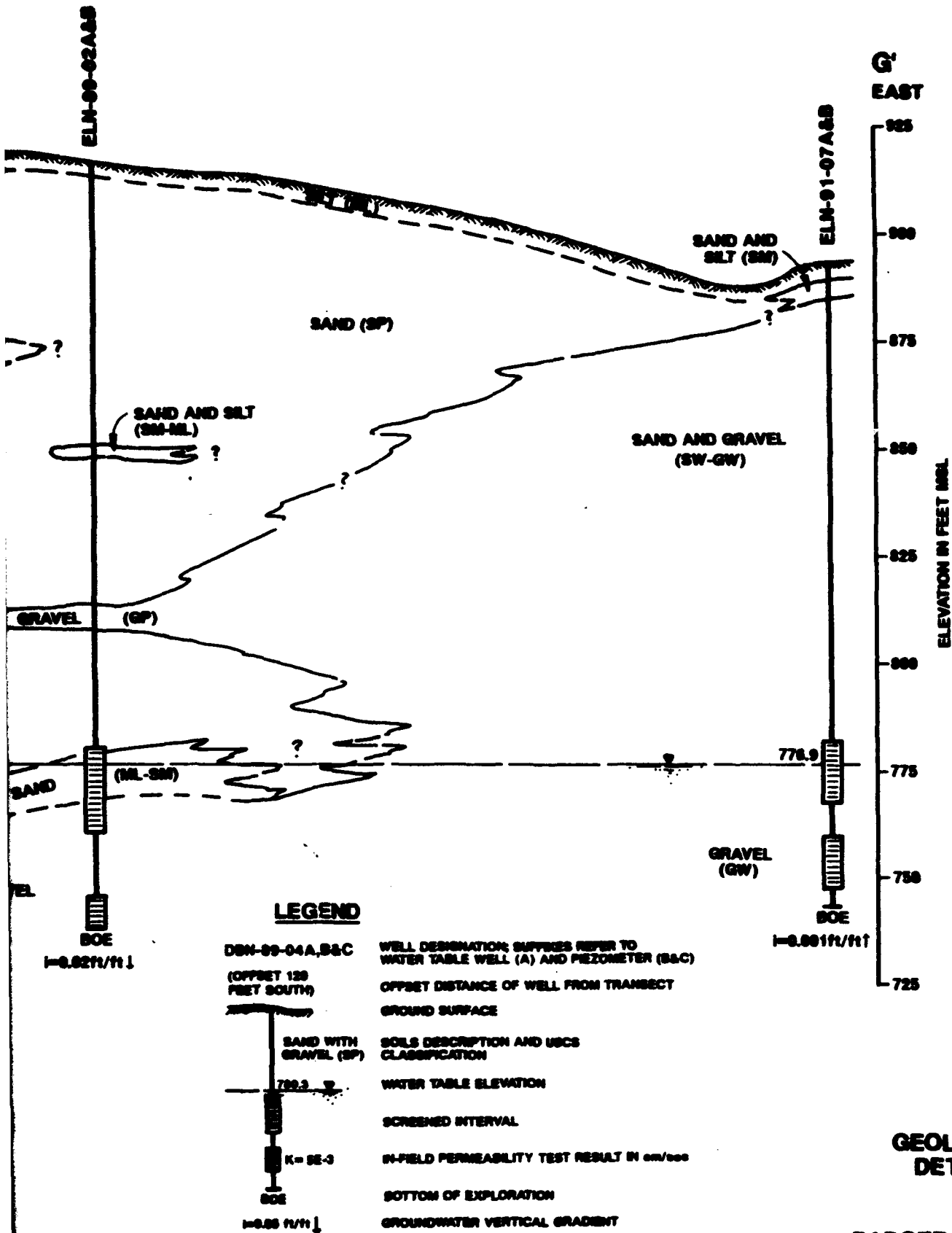






**NOTES:**

1. SEE FIGURE 7-7 FOR LOCATION ORIENTATION OF PROFILE
2. PROFILES ARE BASED ON INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACT BETWEEN EXPLORATIONS THOSE SHOWN.
3. WATER LEVELS MEASURED TABLE WELLS ON 12/16/91
4. LAYERED SILT AND CLAY (SL) AND SAND AND SILT (SM) DISCONTINUOUS EAST OF



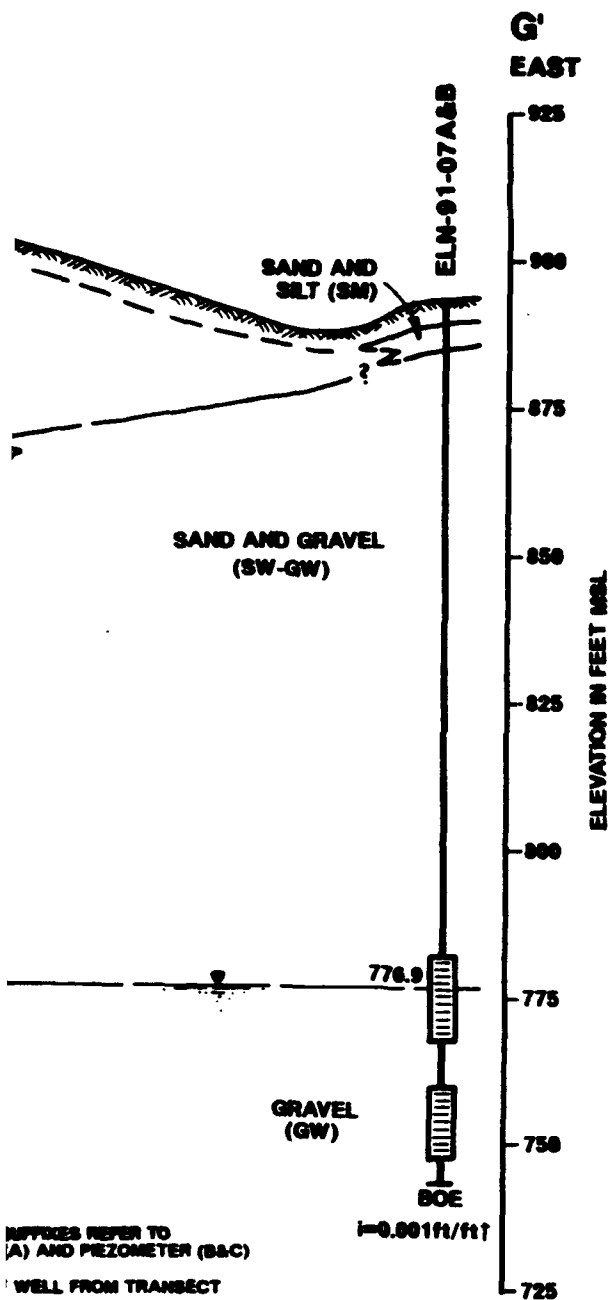
**FIGURE 7-7  
GEOLOGIC CROSS SECTION  
DETERRENT BURNING G  
AND EXISTING LA  
REMEDIAL INVESTIG  
BADGER ARMY AMMUNITION**

ABS Environmental Services



**NOTES:**

1. SEE FIGURE 7-7 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
4. LAYERED SILT AND CLAY GRADES TO A SILT AND SAND AND BECOMES DISCONTINUOUS EAST OF ELM-99-01.



DIFFERENCES REFER TO  
(A) AND PIEZOMETER (B&C)  
WELL FROM TRANSECT

AND USCS

TION

ITY TEST RESULT IN cm/sec

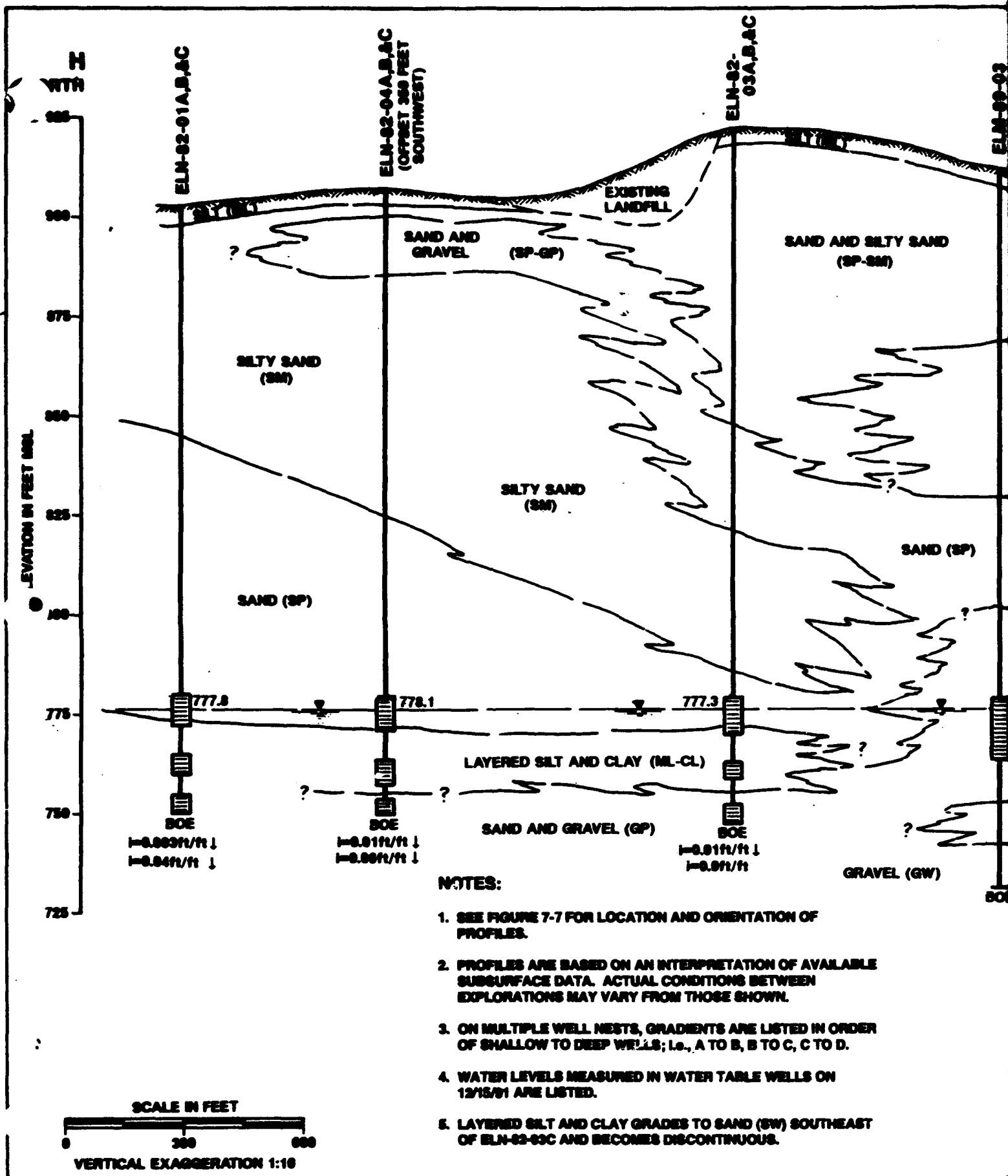
ITION

ICAL GRADIENT

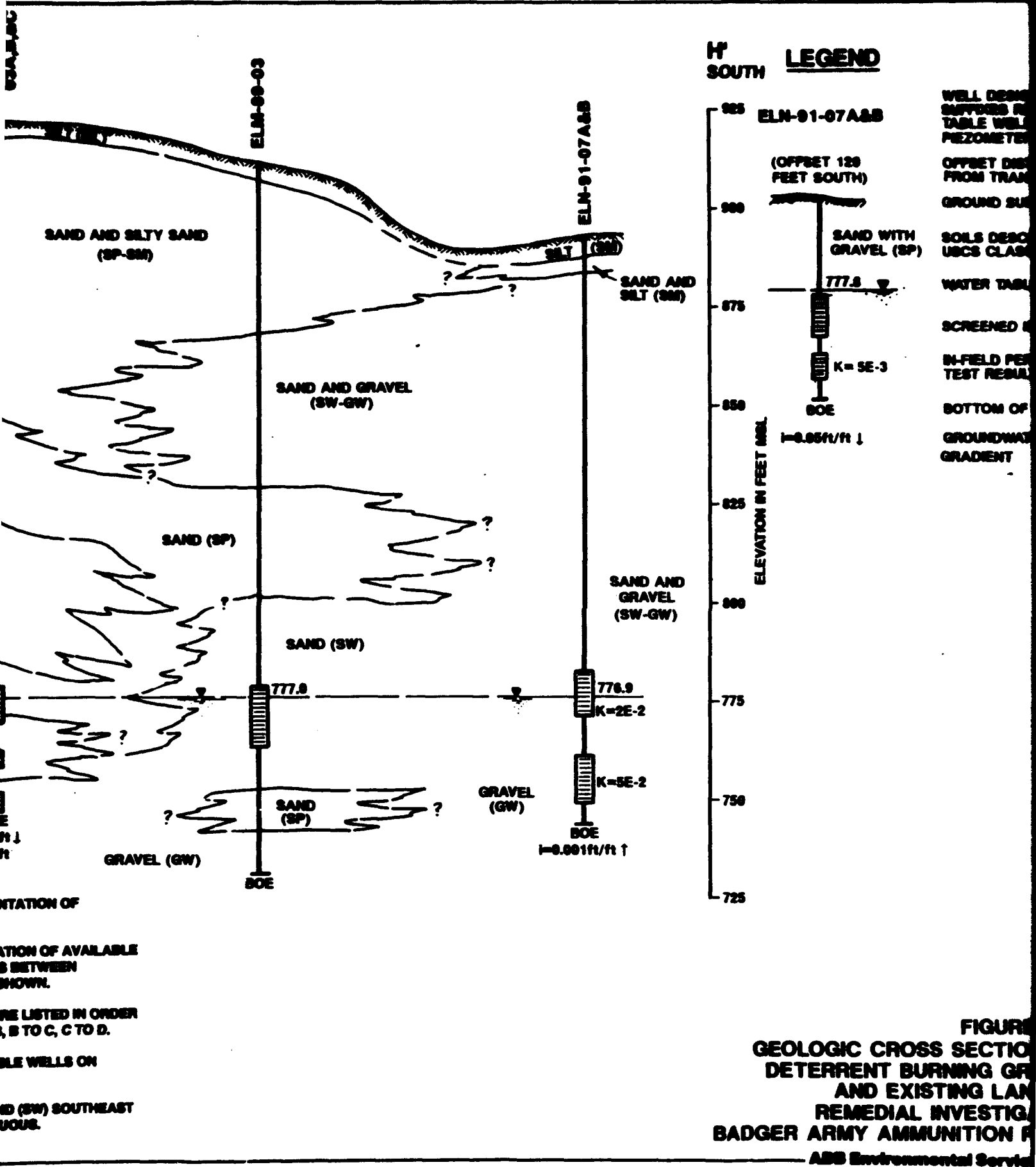
**FIGURE 7-11  
GEOLOGIC CROSS SECTION G-G'  
DETERRENT BURNING GROUND  
AND EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABS Environmental Services, Inc.



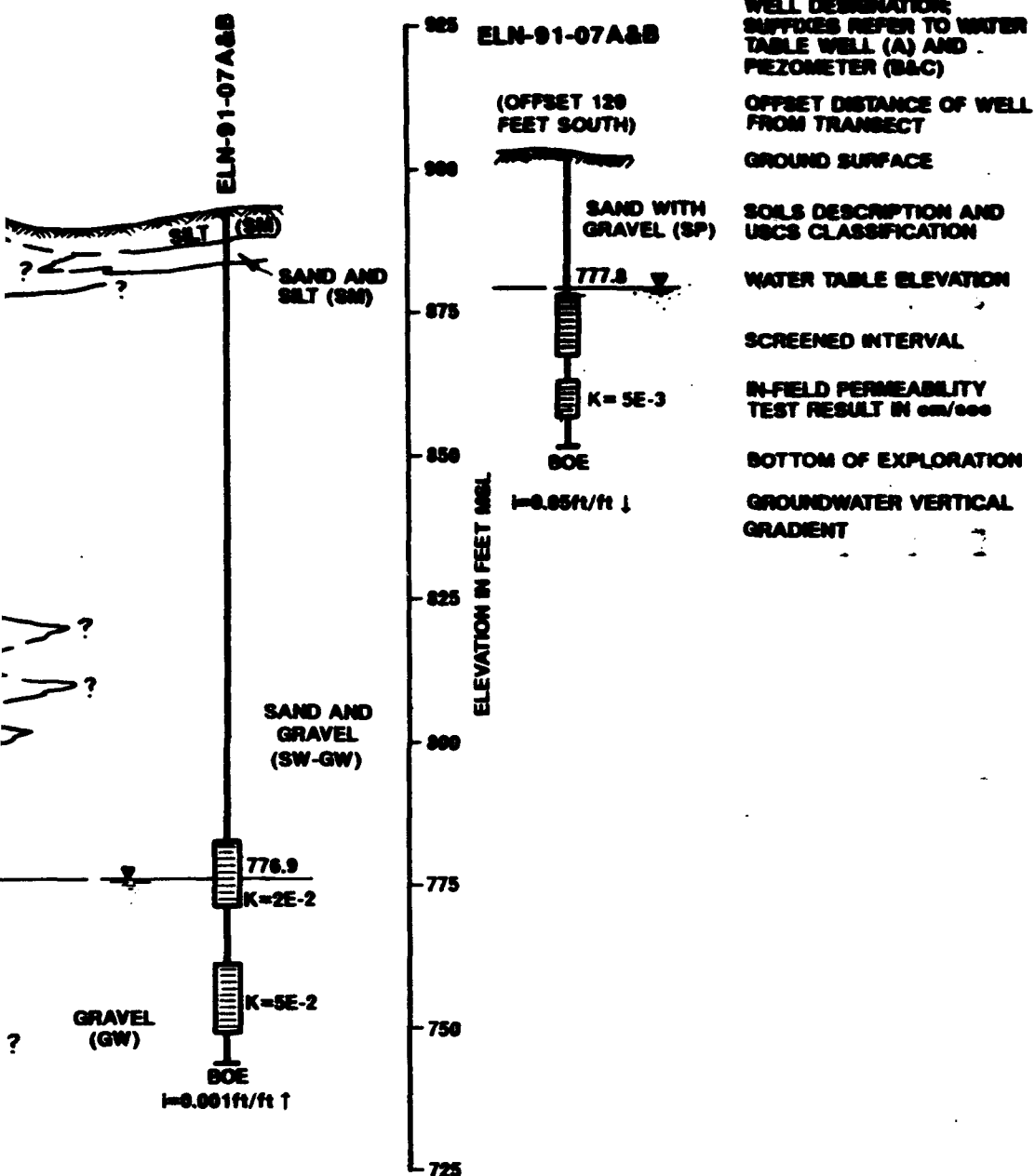








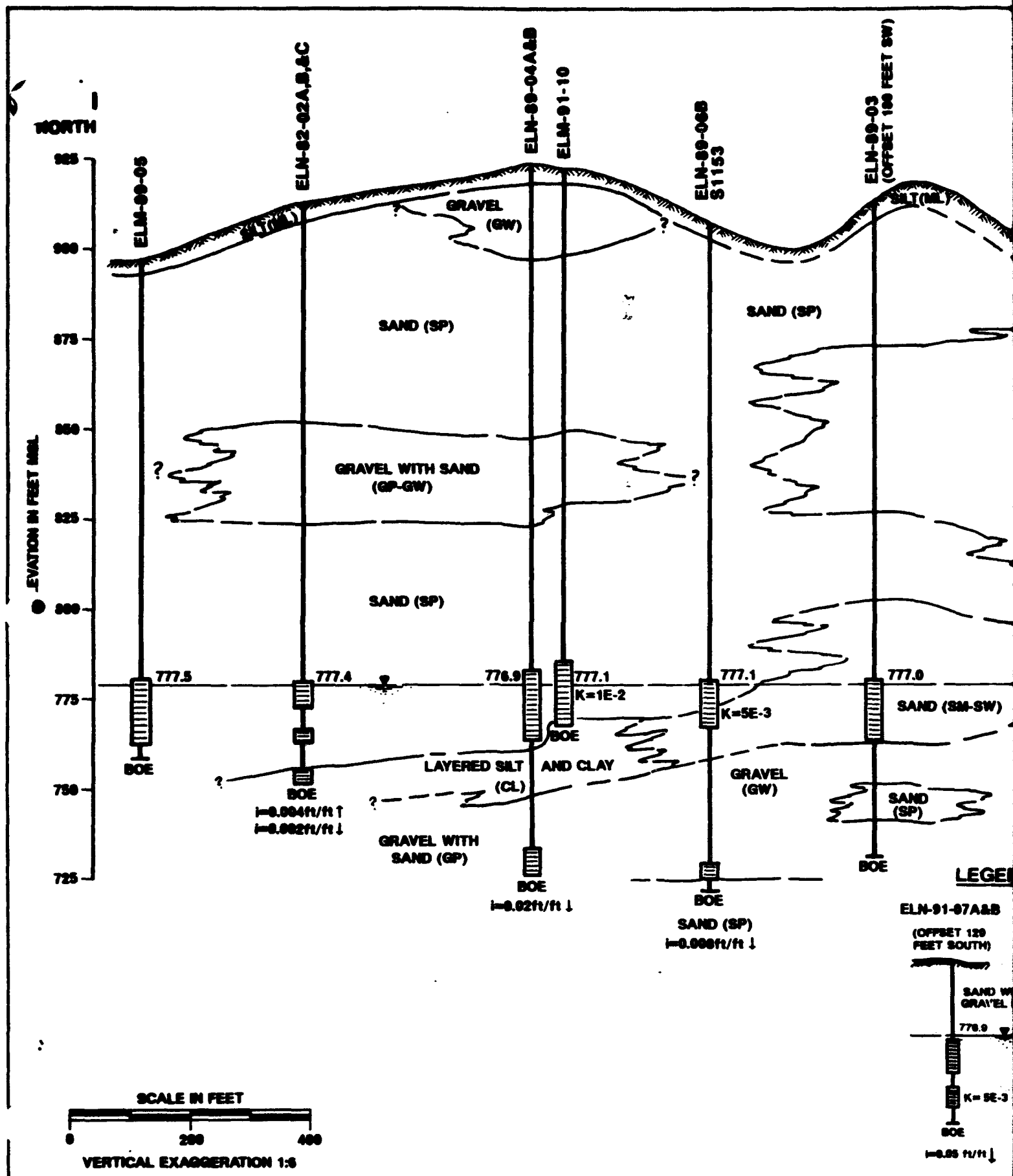
# **H'** **SOUTH**      **LEGEND**



**FIGURE 7-12**  
**GEOLOGIC CROSS SECTION H-H'**  
**DETERRENT BURNING GROUND**  
**AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





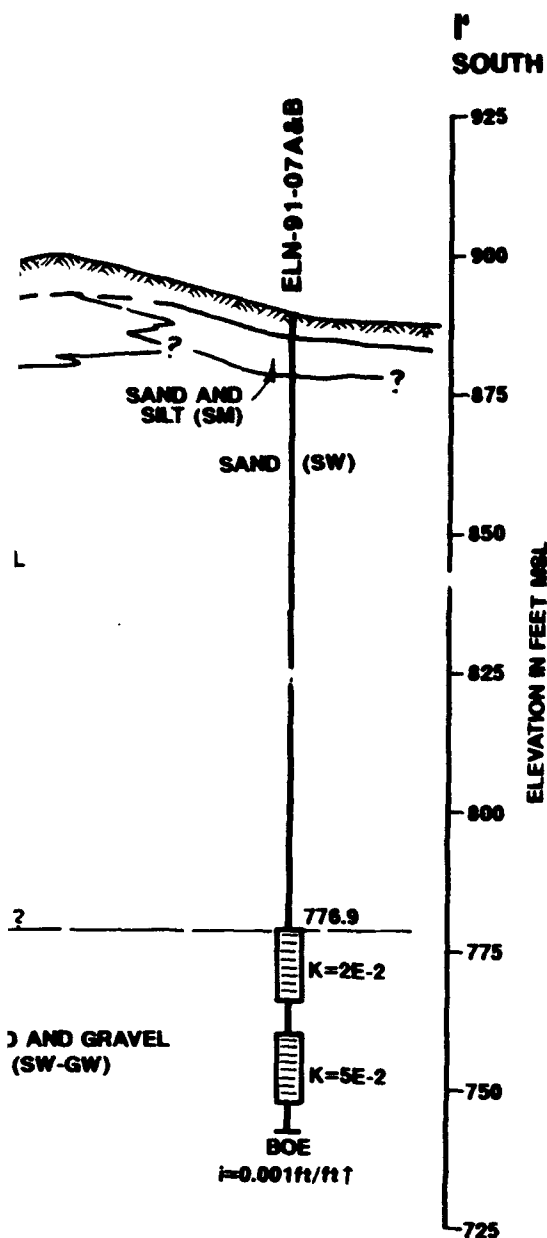






**NOTES:**

1. SEE FIGURE 7-7 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. ON MULTIPLE WELL NESTS, GRADIENTS ARE LISTED IN ORDER OF SHALLOW TO DEEP WELLS; I.e., A TO B, B TO C, C TO D.
4. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91 ARE LISTED.
5. LAYERED SILT AND CLAY BECOMES DISCONTINUOUS SOUTH OF ELM-91-10 AND APPEARS TO GRADE TO SAND (SM-SW).



SUFFIXES REFER TO  
(A) AND PIEZOMETER (B&C)  
OF WELL FROM TRANSECT

AND USCS

ATION

IL

ITY TEST RESULT IN cm/sec

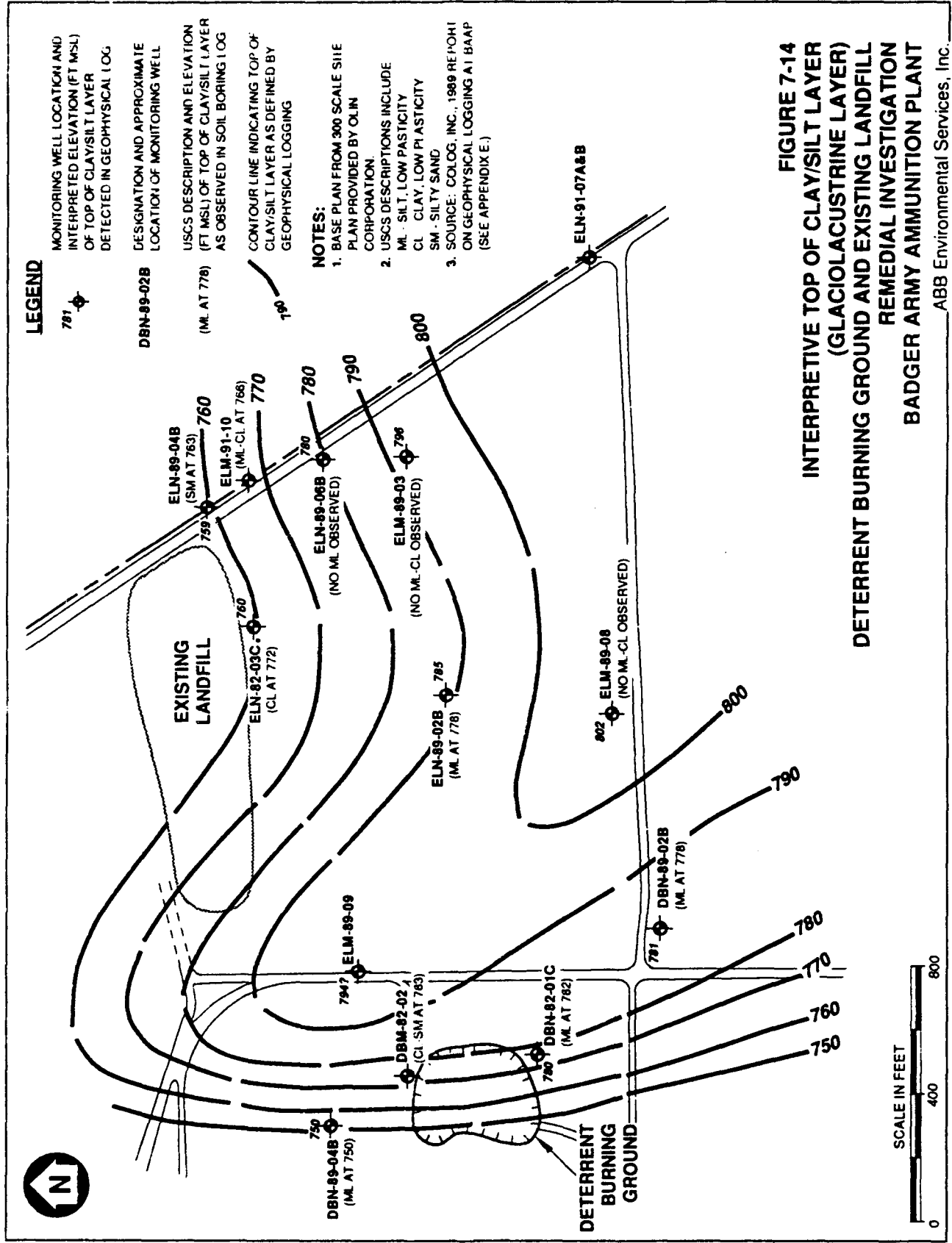
RATION

ITICAL GRADIENT

**FIGURE 7-13  
GEOLOGIC CROSS SECTION I-I'  
DETERRENT BURNING GROUND  
AND EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABS Environmental Services, Inc.









81132

ELN-82-01A,B,C  
777.8

Production  
Well No. 4

ELN-82-04A,B,C  
778.1

DBN-82-04A,B  
780.3

ELN-82-03  
778.2

DBM-82-02  
780.8

DETERRENT  
BURNING  
GROUND

DBB-81-03

781

DBB-81-02

DBB-81-01

DBM-82-01

DBN-82-01A 3C  
8-1122

DBM-82-05  
782.9

DBM-82-01  
780.1

DBN-82-02A,B

### LEGEND

ELN-82-05 SINGLE MONITORING WELL

ELN-82-02  
A,B,C MONITORING WELL NEST

APPROXIMATE DIRECTION OF GROUNDWATER FLOW  
BASED ON GROUNDWATER ELEVATIONS OF THE  
SHALLOW ELEVATED/PERCHED SYSTEM

783 CONTOUR LINE INDICATING INTERPRETED SHALLOW  
ELEVATED GROUNDWATER ELEVATION

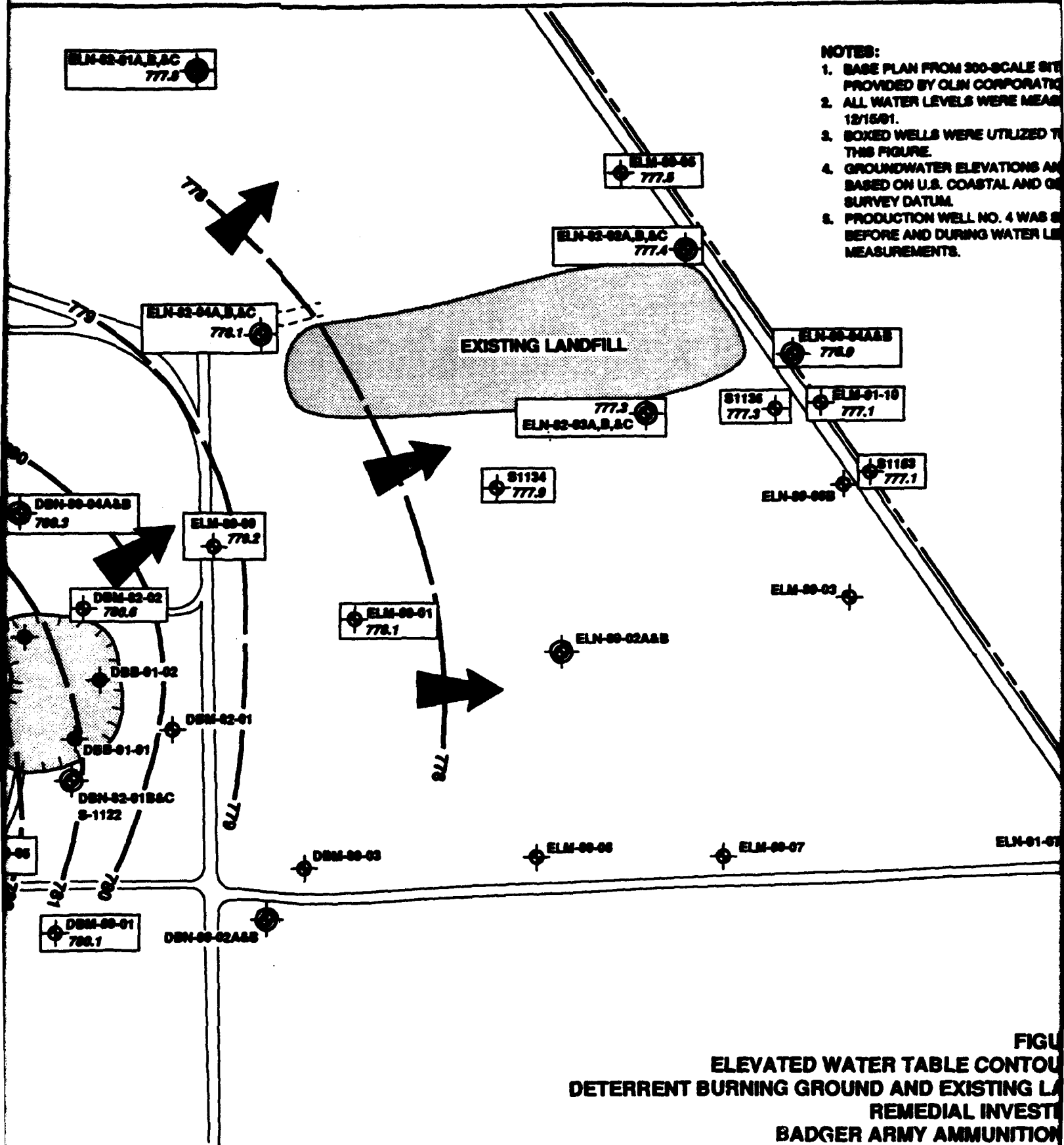
780.8 WATER LEVEL MEASURED IN CORRESPONDING WELL.  
AT NESTED WELL LOCATIONS THE WATER LEVEL WAS  
MEASURED IN THE "A" WELL.

SCALE IN FEET

0 300 600

82080800 de n q



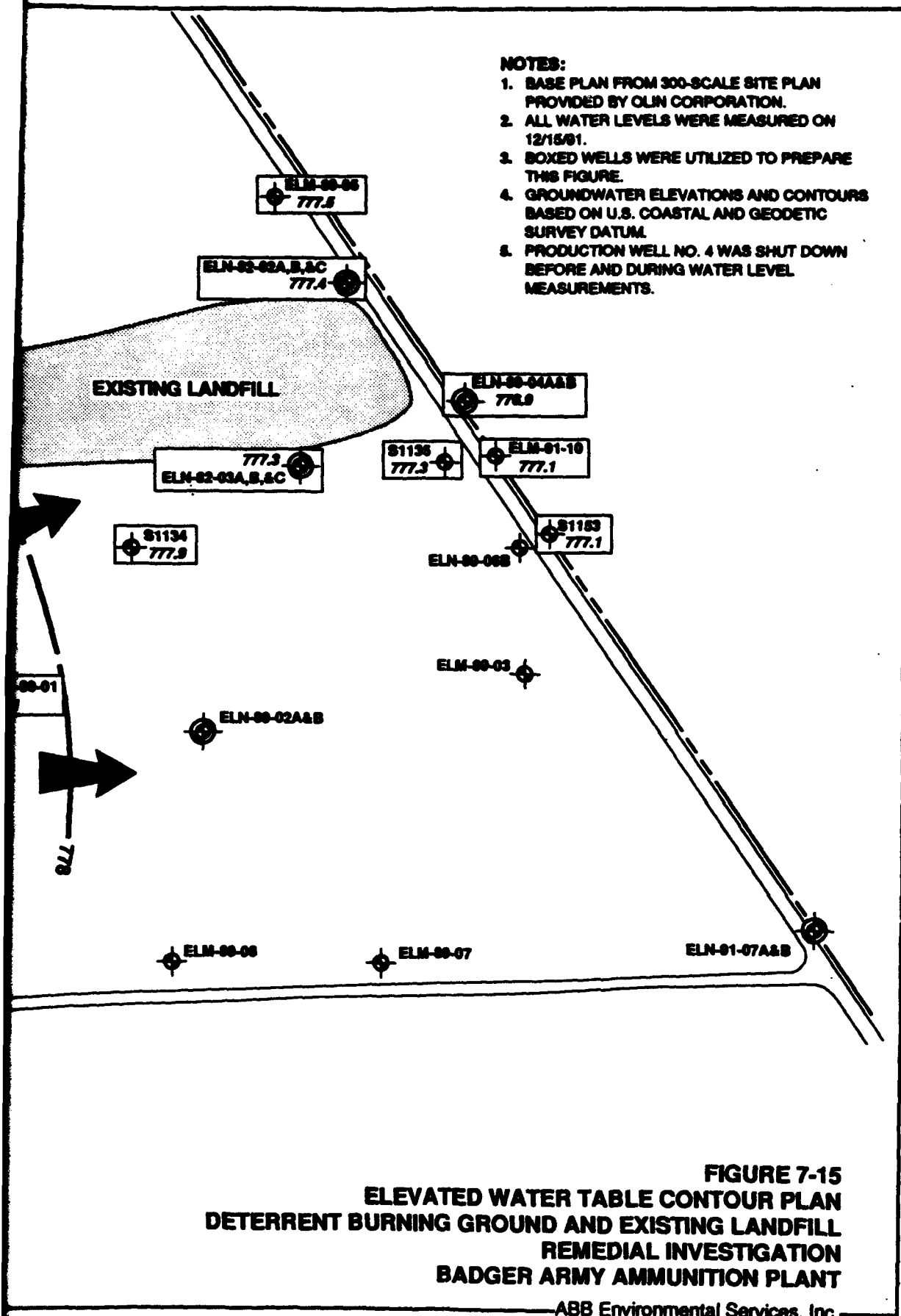


**FIGURE 1**  
**ELEVATED WATER TABLE CONTOUR**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**



**NOTES:**

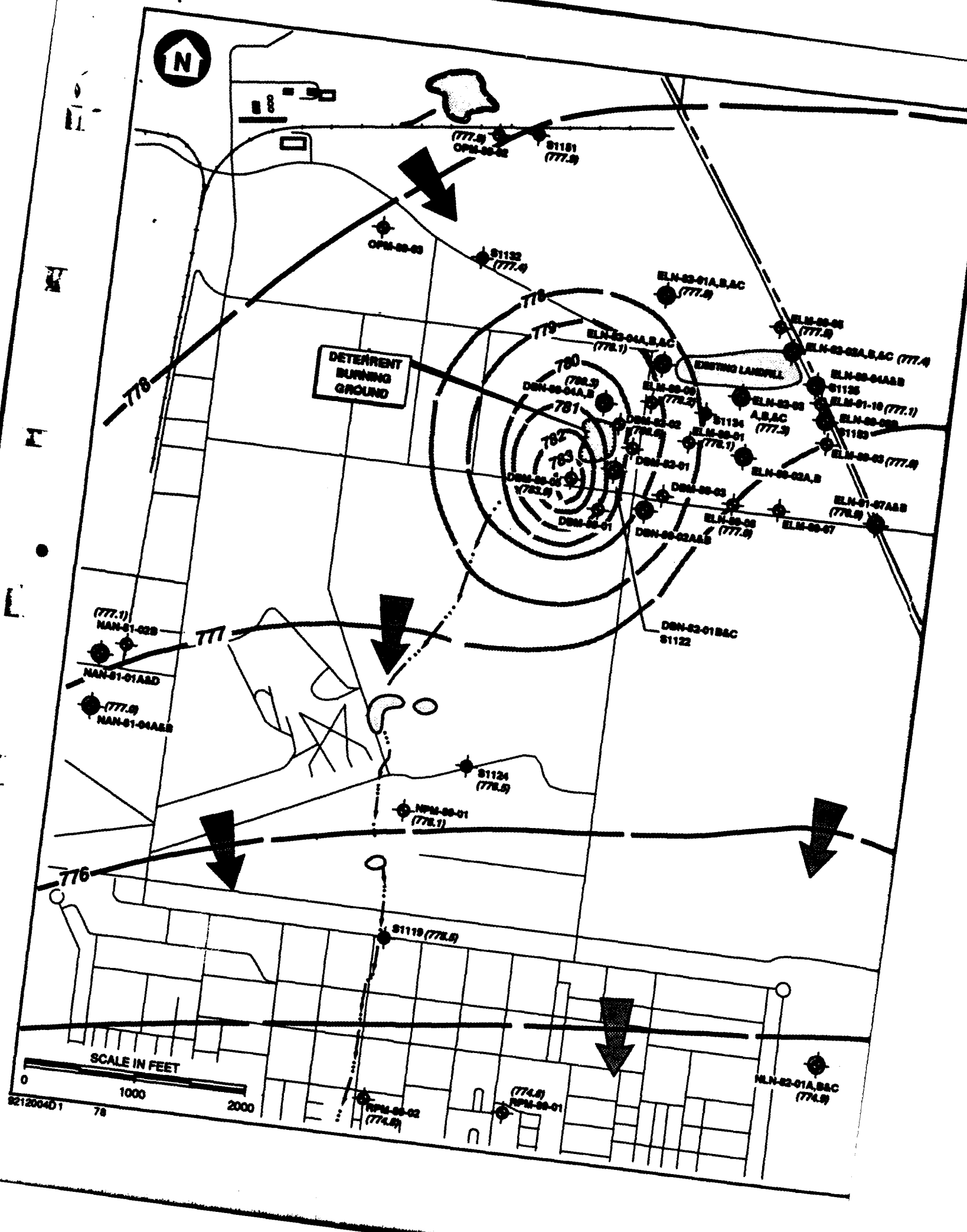
1. BASE PLAN FROM 300-SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. ALL WATER LEVELS WERE MEASURED ON 12/15/91.
3. BOXED WELLS WERE UTILIZED TO PREPARE THIS FIGURE.
4. GROUNDWATER ELEVATIONS AND CONTOURS BASED ON U.S. COASTAL AND GEODETIC SURVEY DATUM.
5. PRODUCTION WELL NO. 4 WAS SHUT DOWN BEFORE AND DURING WATER LEVEL MEASUREMENTS.



**FIGURE 7-15  
ELEVATED WATER TABLE CONTOUR PLAN  
DETERRENT BURNING GROUND AND EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

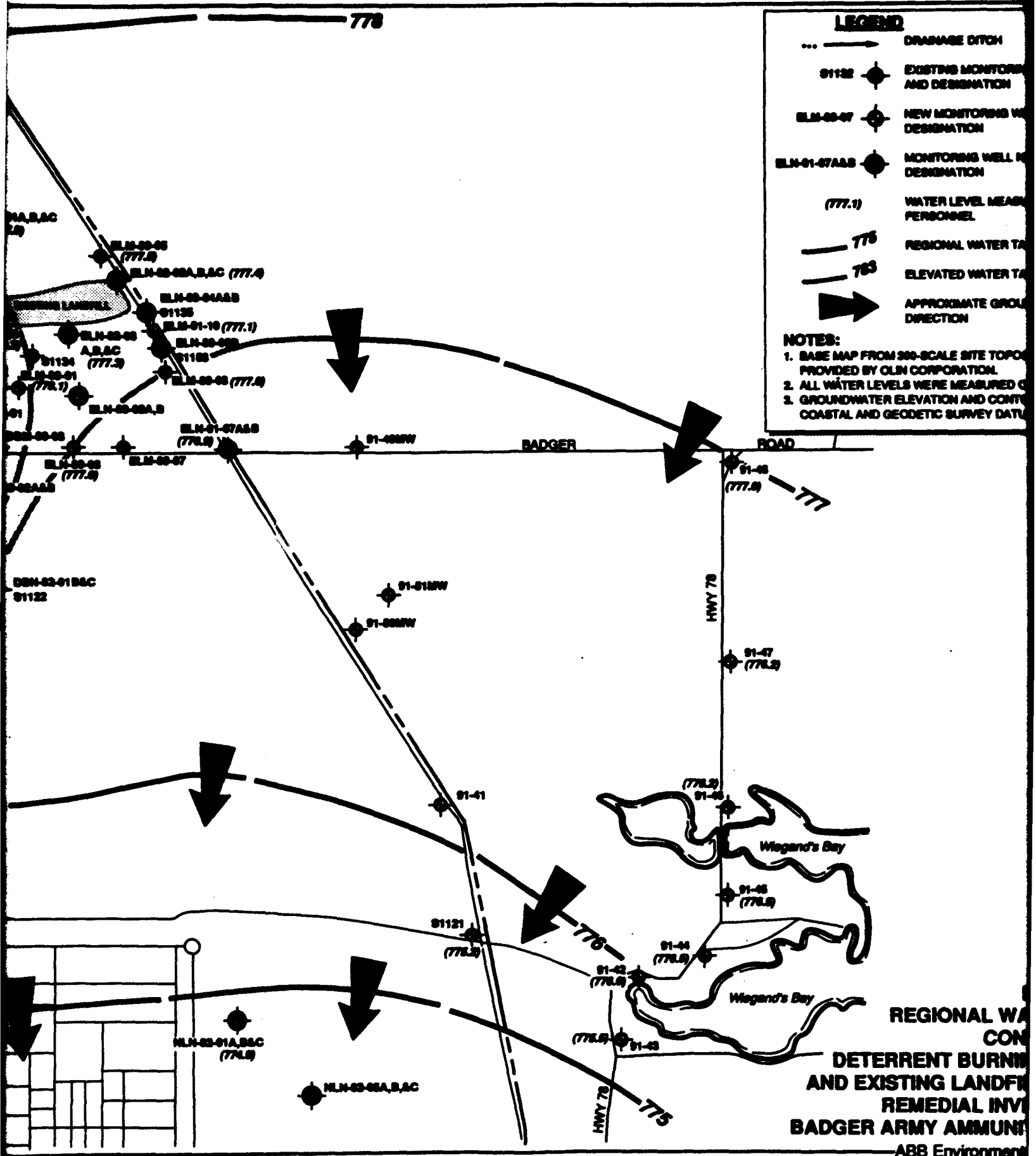




921200401

78









**NOTES:**

1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHY PROVIDED BY OLIN CORPORATION.
2. ALL WATER LEVELS WERE MEASURED ON JULY 19, 1990.
3. GROUNDWATER ELEVATION AND CONCENTRATION DATA FROM COASTAL AND GEODETIC SURVEY DATA.

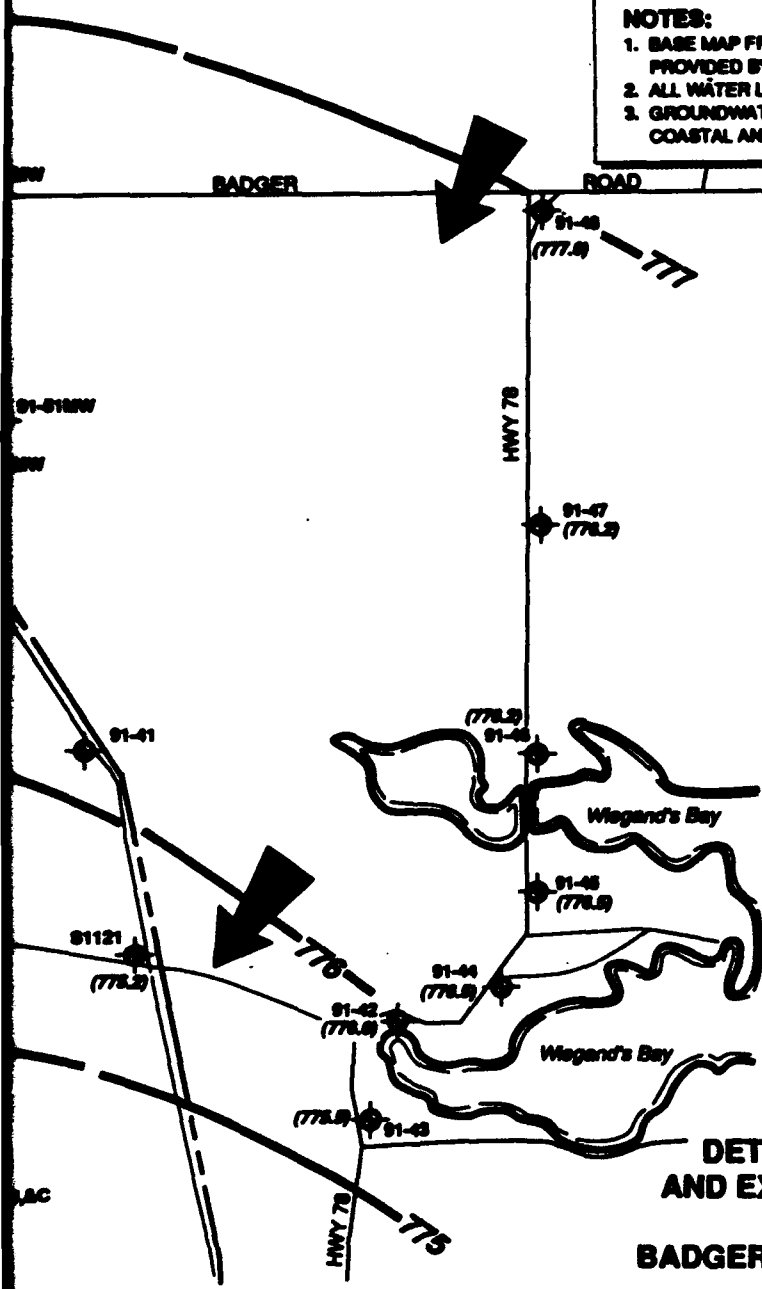


**LEGEND**

- > DRAINAGE DITCH
- 91122  EXISTING MONITORING WELL LOCATION AND DESIGNATION
- ELM-88-87  NEW MONITORING WELL LOCATION AND DESIGNATION
- ELN-91-87A&B  MONITORING WELL NEST LOCATION AND DESIGNATION
- (777.1) WATER LEVEL MEASURED BY ABB-ES PERSONNEL
- T75 REGIONAL WATER TABLE CONTOUR LINE
- T83 ELEVATED WATER TABLE CONTOUR LINE
-  APPROXIMATE GROUNDWATER FLOW DIRECTION

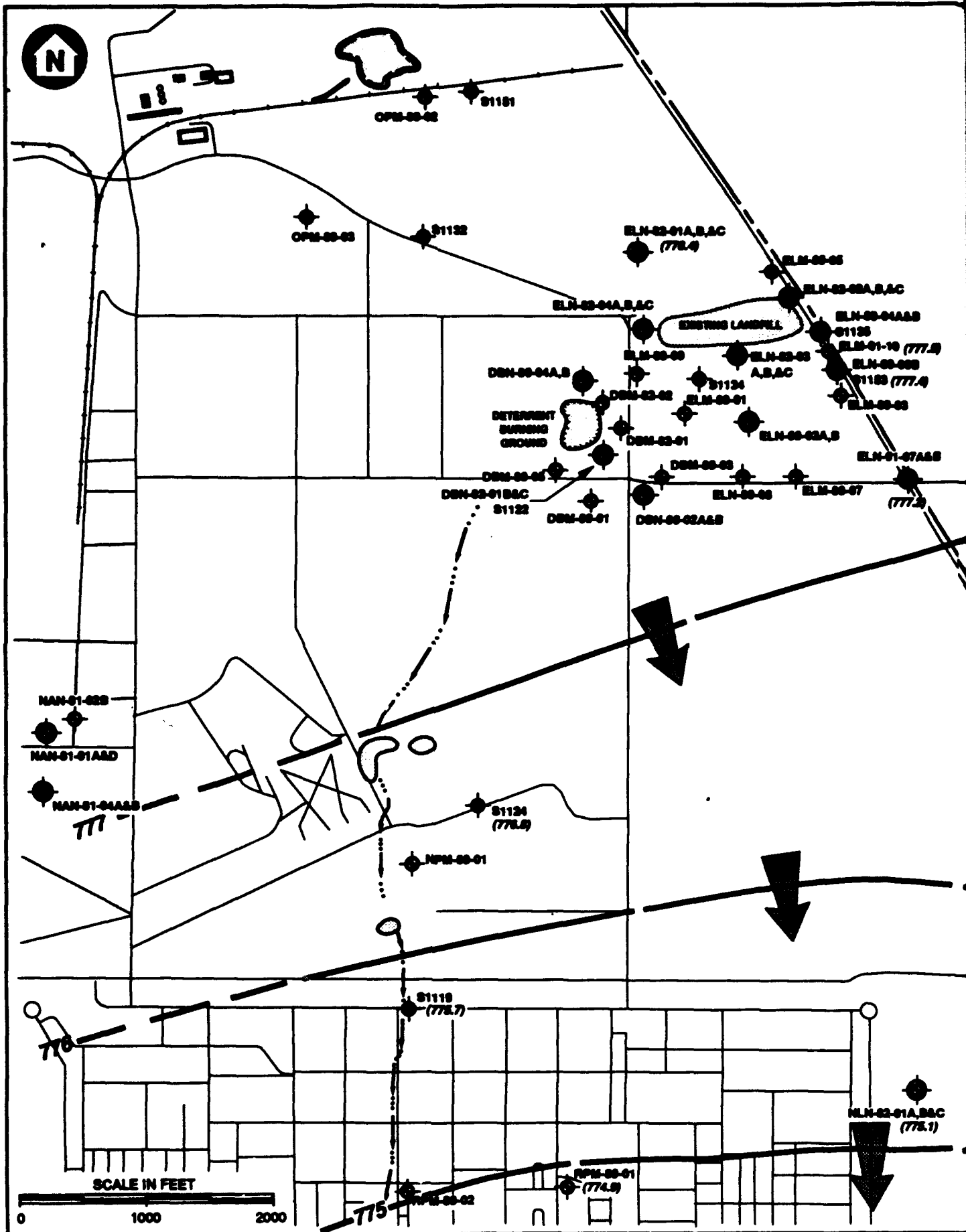
**NOTES:**

1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLN CORPORATION.
2. ALL WATER LEVELS WERE MEASURED ON 8/8/92.
3. GROUNDWATER ELEVATION AND CONTOURS BASED ON U.S. COASTAL AND GEODETIC SURVEY DATUM.



**FIGURE 7-16**  
**REGIONAL WATER TABLE**  
**CONTOUR PLAN**  
**DETERRENT BURNING GROUND**  
**AND EXISTING LANDFILL (12/15/91)**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.





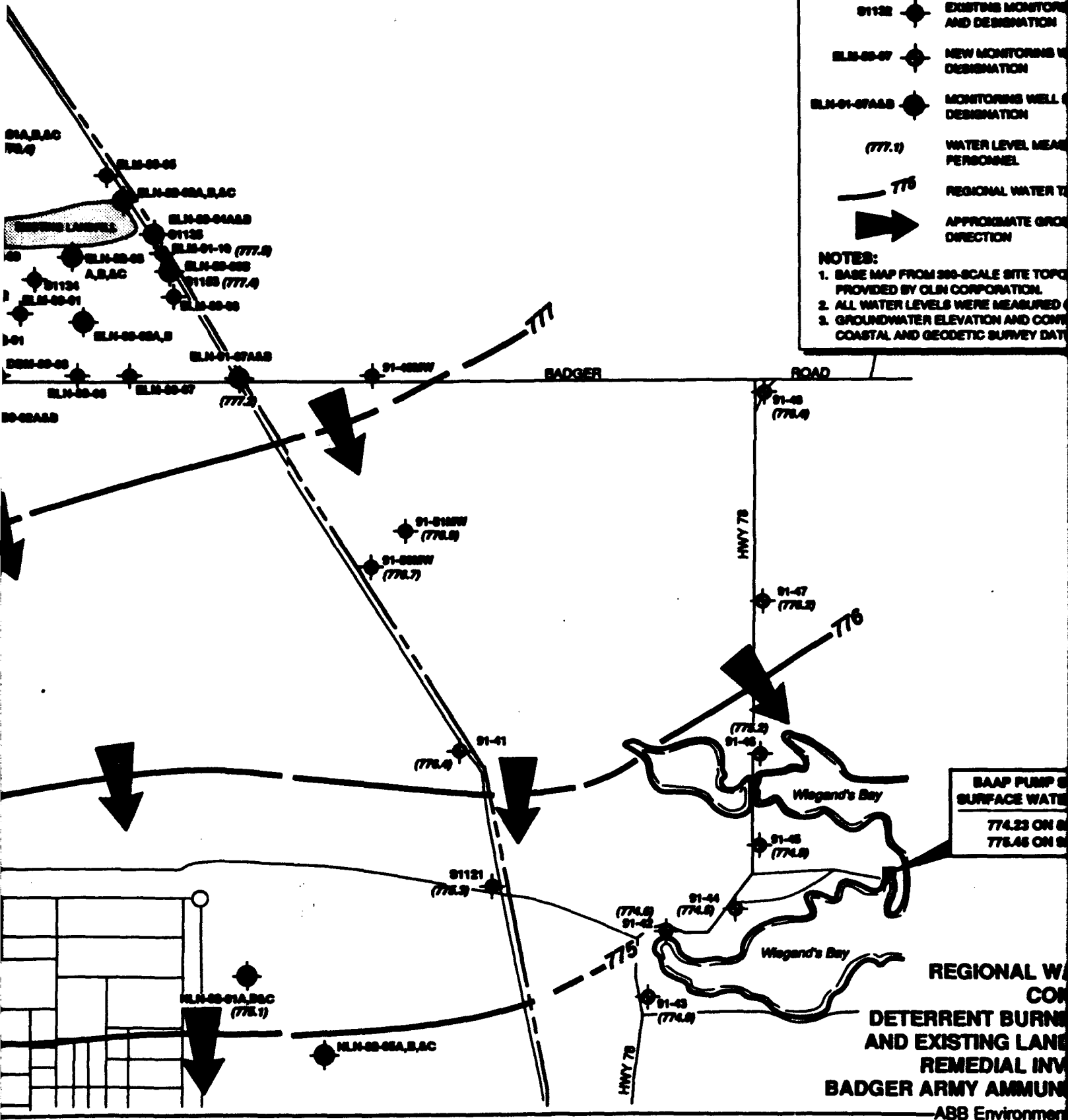


# LEGEND

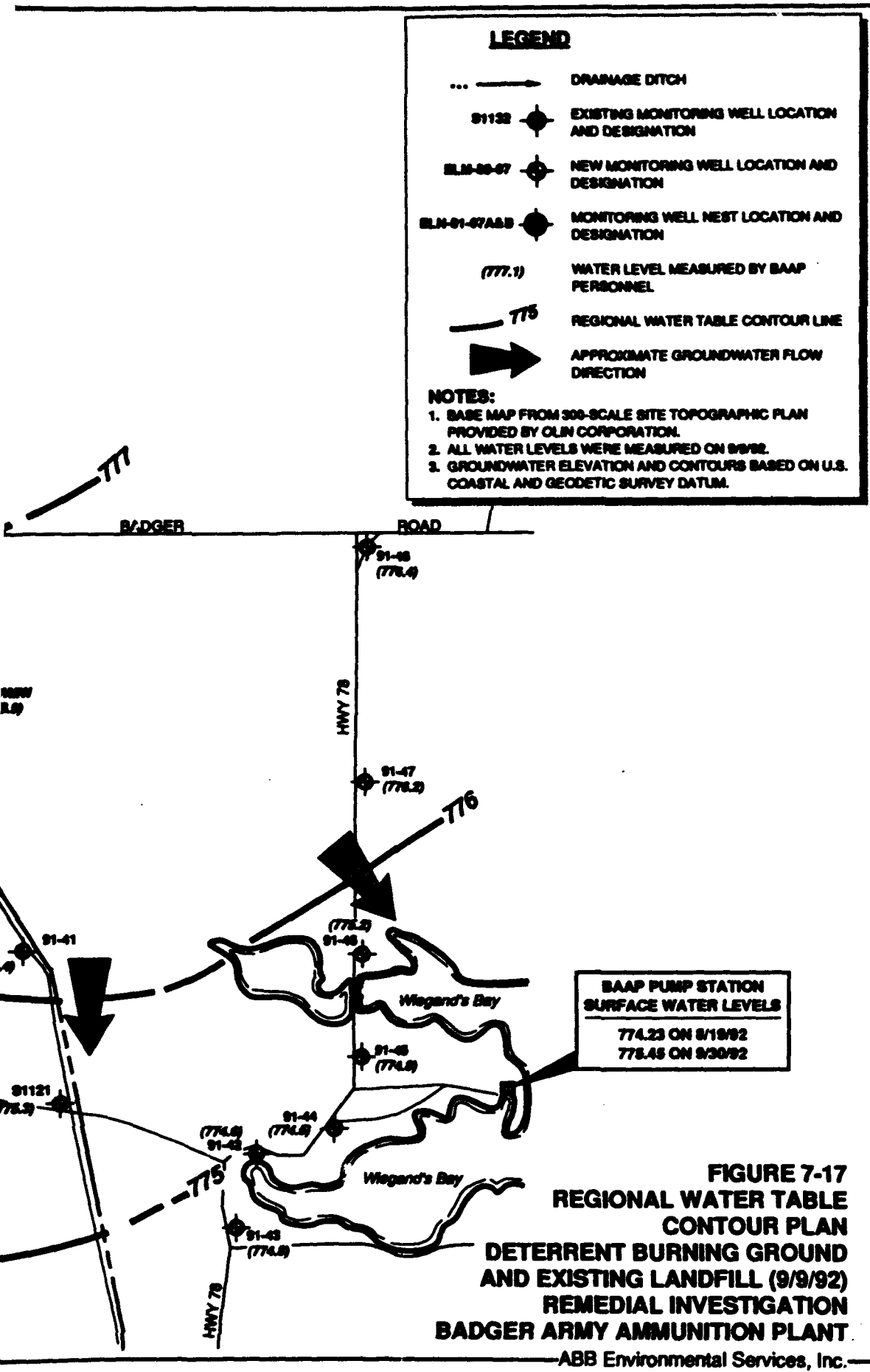
- > DRAINAGE DITCH
- 91132 ● EXISTING MONITOR AND DESIGNATION
- ELN-99-07 ● NEW MONITORING WELL DESIGNATION
- ELN-01-07AAS ● MONITORING WELL DESIGNATION
- (777.1) WATER LEVEL MEASUREMENT PERSONNEL
- T75 REGIONAL WATER TABLE
- ➔ APPROXIMATE GROUNDWATER DIRECTION

## NOTES:

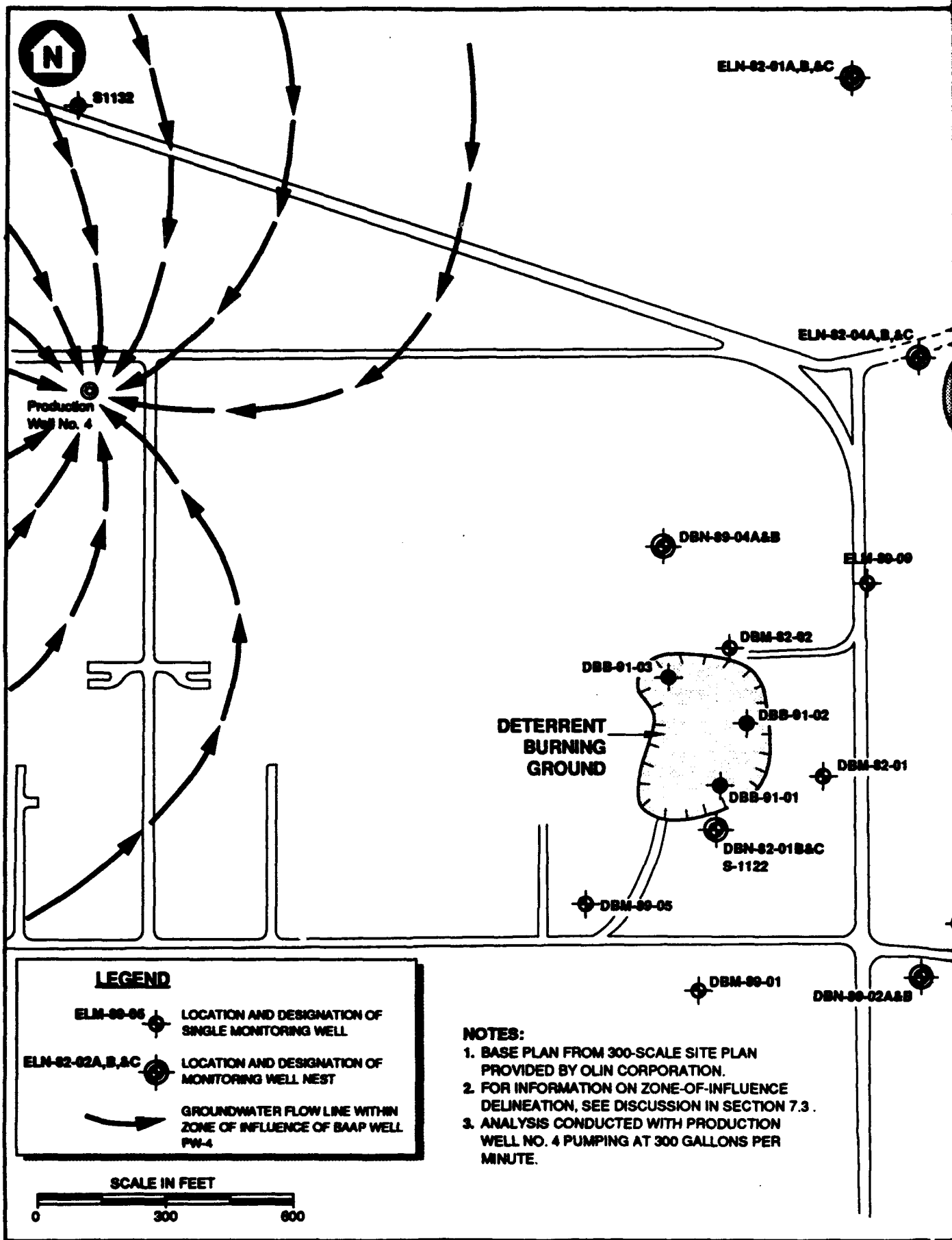
1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHY PROVIDED BY OLN CORPORATION.
2. ALL WATER LEVELS WERE MEASURED ON 1/1/99.
3. GROUNDWATER ELEVATION AND CONCENTRATION DATA FROM COASTAL AND GEODETIC SURVEY DATA.



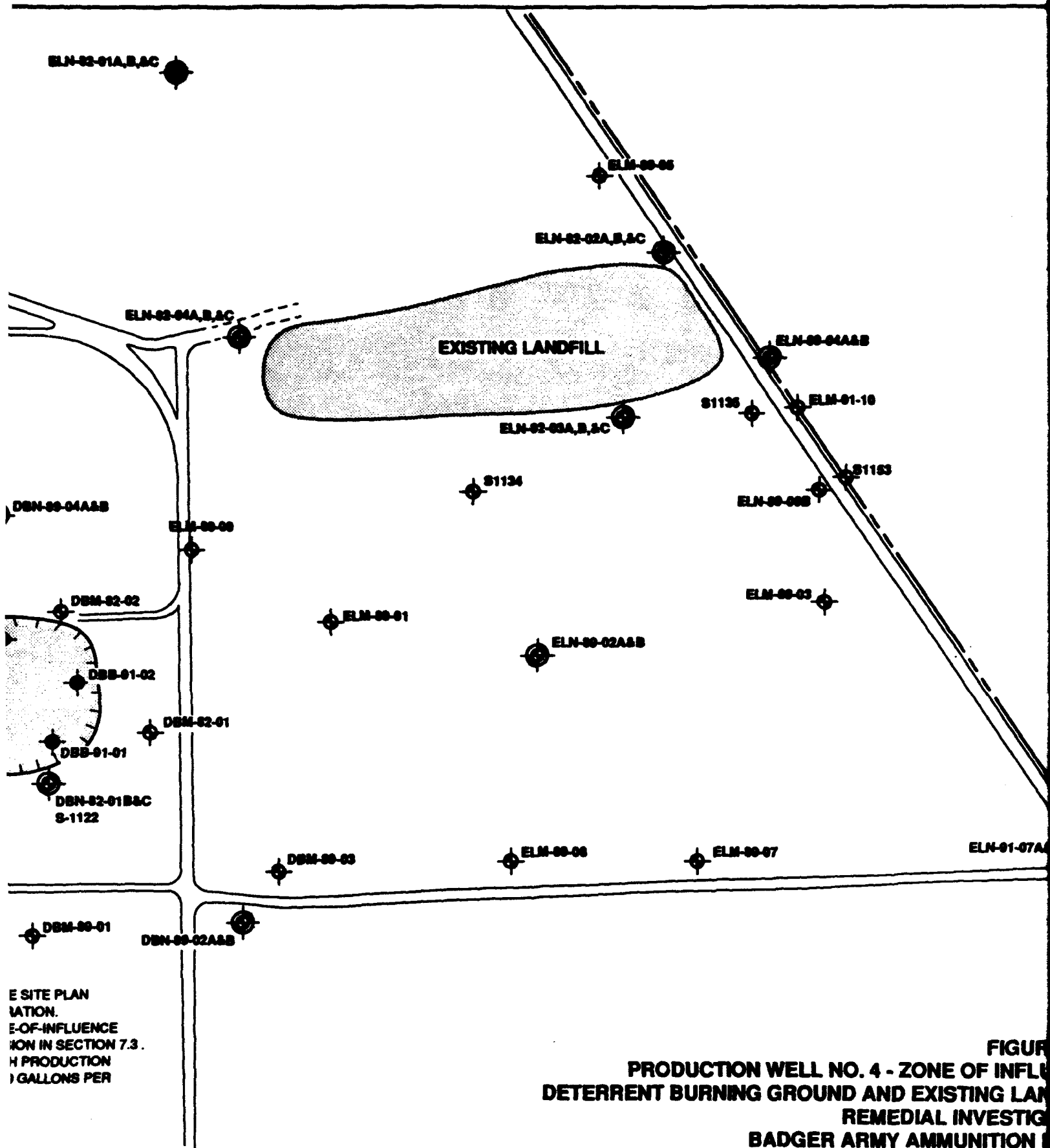






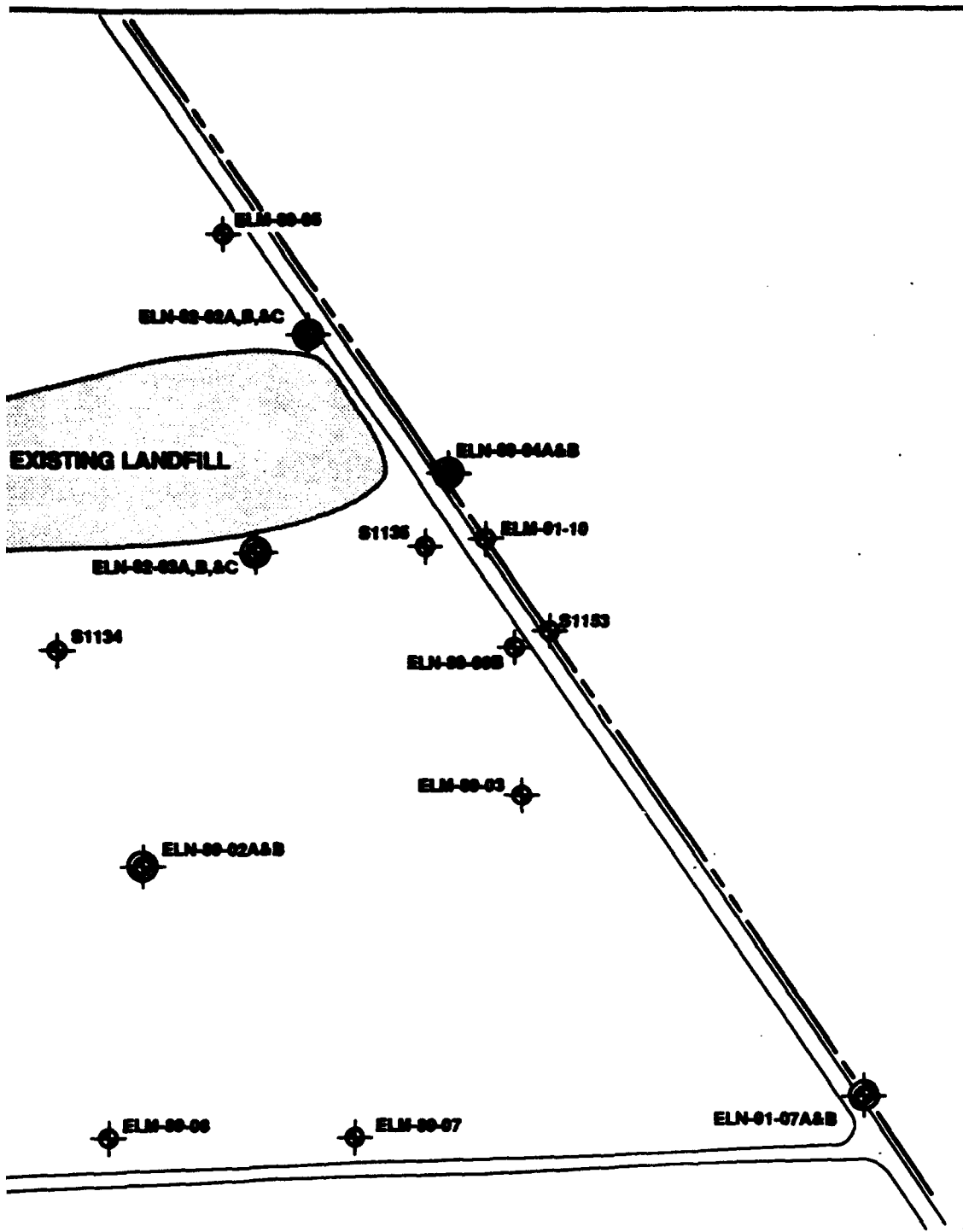






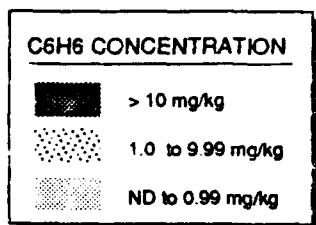
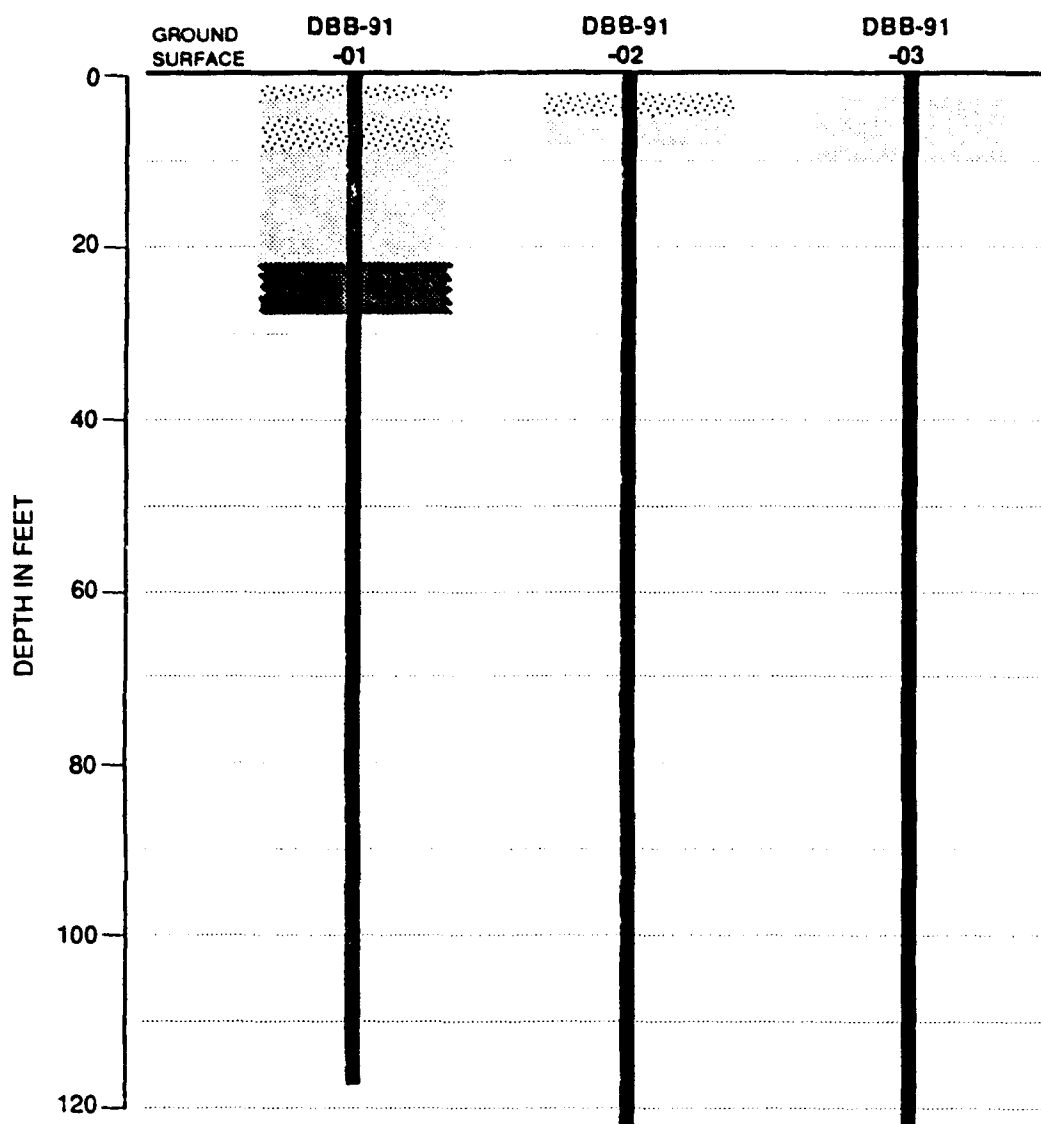
**FIGURE 1**  
**PRODUCTION WELL NO. 4 - ZONE OF INFLUENCE**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION SITE**





**FIGURE 7-18**  
**PRODUCTION WELL NO. 4 - ZONE OF INFLUENCE**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**



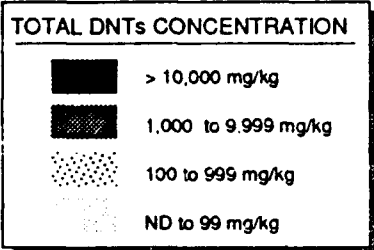
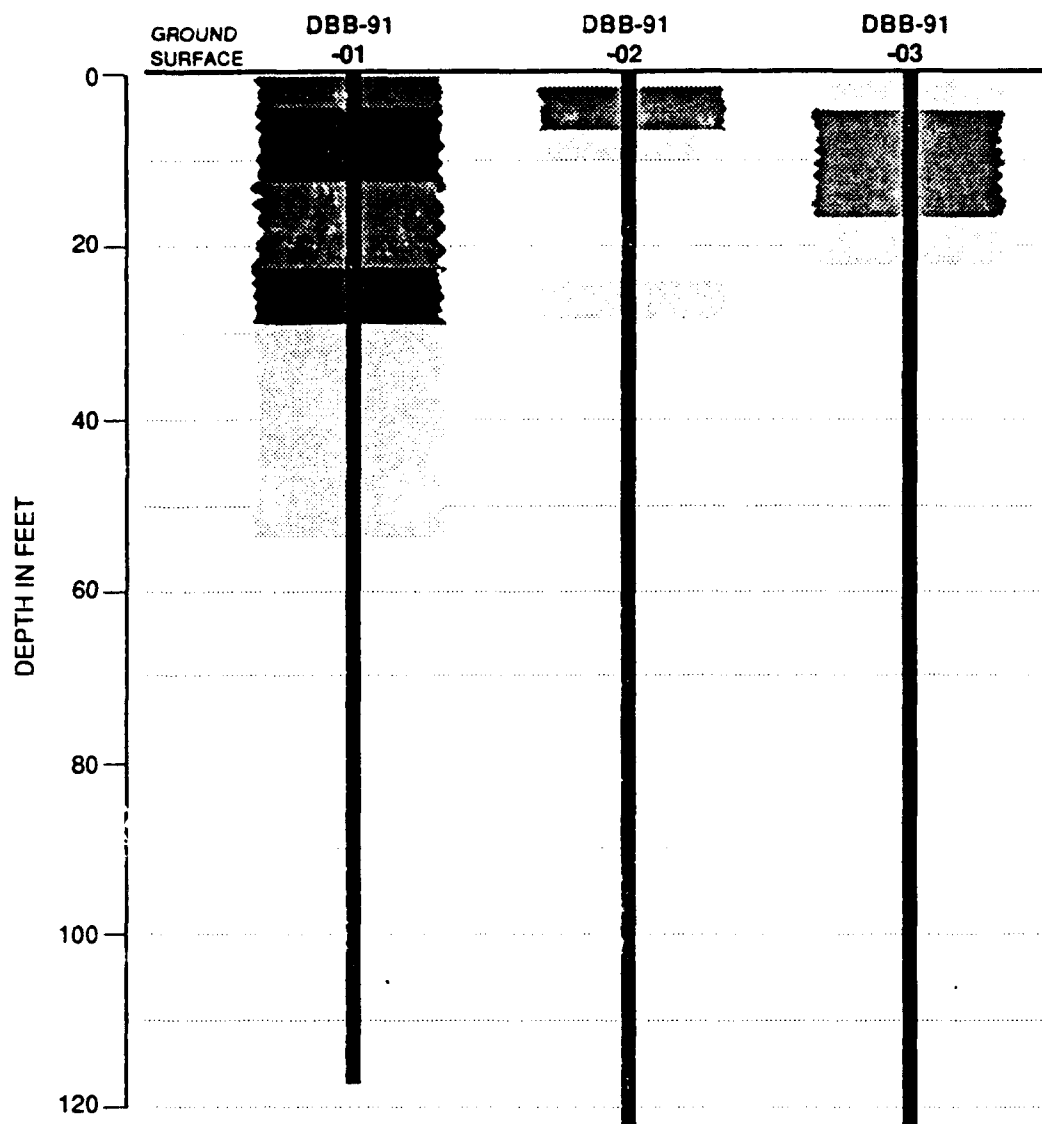


NOTE:  
SEE TABLE 7-12 AND APPENDIX K  
FOR CHEMICAL DATA SUMMARY.

**FIGURE 7-19**  
**TOTAL C6H6 CONCENTRATIONS IN**  
**SUBSURFACE SOILS**  
**DETERRENT BURNING GROUND WASTE PITS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



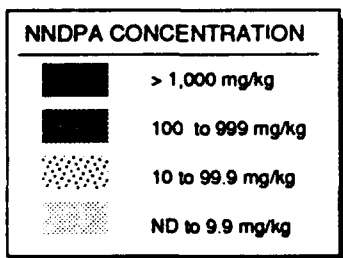
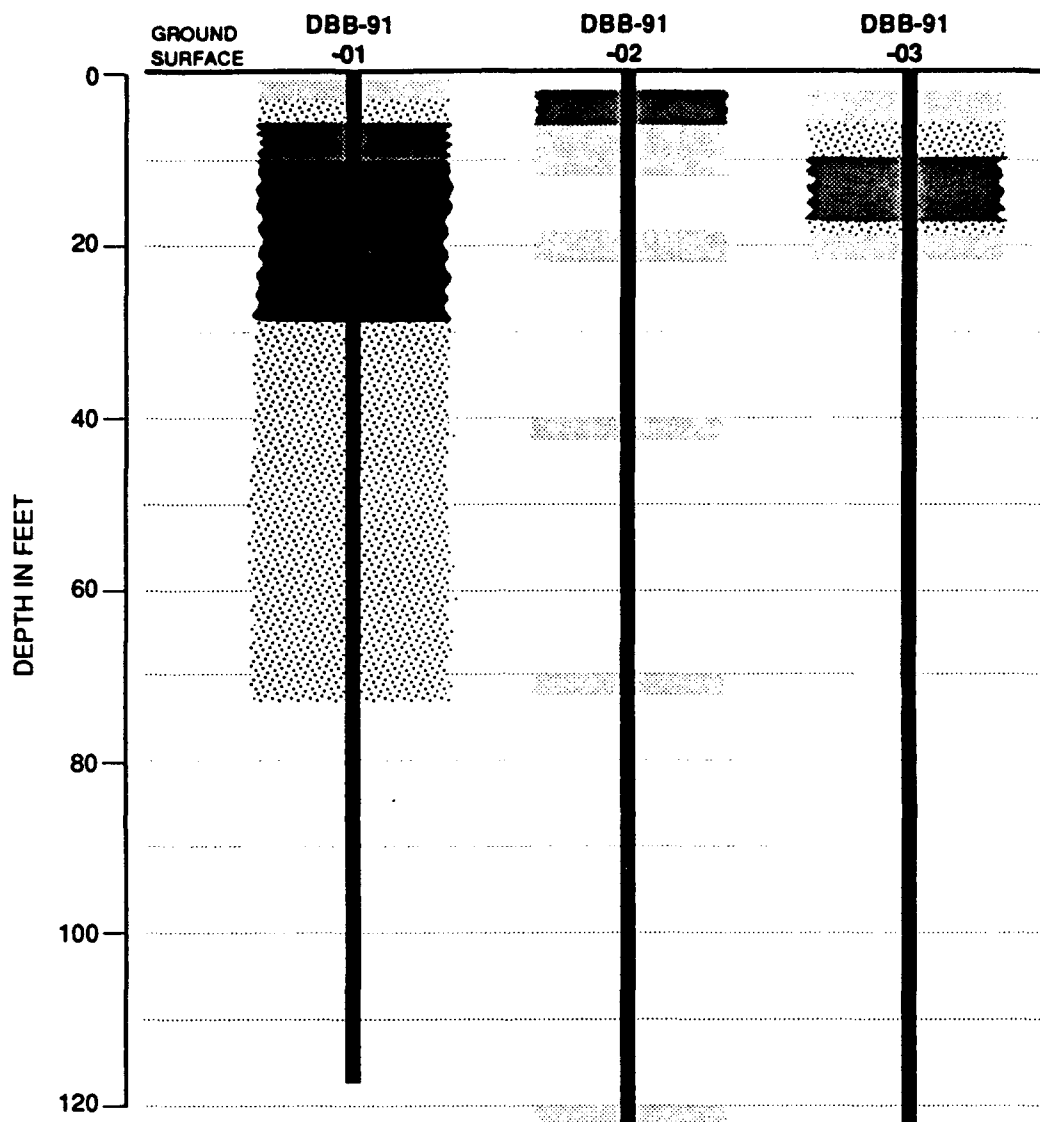


**NOTE:**  
SEE TABLE 7-12 AND APPENDIX K  
FOR CHEMICAL DATA SUMMARY.

**FIGURE 7-20**  
**TOTAL DNTs CONCENTRATIONS IN SUBSURFACE SOILS**  
**DETERRENT BURNING GROUND WASTE PITS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





NOTE:  
SEE TABLE 7-12 AND APPENDIX K  
FOR CHEMICAL DATA SUMMARY.

**FIGURE 7-21**  
**NNDPA CONCENTRATIONS IN**  
**SUBSURFACE SOILS**  
**DETERRENT BURNING GROUND WASTE PITS**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





S1132

ELN-82-01A,B,&C

ELN-82-04A,B,&C

Production  
Well No. 4

DBN-89-04A&B  
111TCE 3.734.08

ELM-89-09  
111TCE 3.877.88  
112TCE 0.388-

DBM-82-02  
111TCE 8.34/12.1  
NNCPA -1.02

DETERRENT  
BURNING  
GROUND

DBB-81-03

DBB-81-02

DBB-81-01

DBM-82-01  
28DNT 2.171.28  
NNCPA 18.714.5

DBN-82-01B&C  
S-1122

DBM-89-05

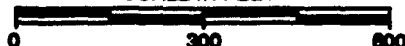
DBM-89-01

DBN-89-02A&B

### LEGEND

- ELM-89-05 LOCATION AND DESIGNATION OF SINGLE MONITORING WELL
- ELN-82-02A,B,&C LOCATION AND DESIGNATION OF MONITORING WELL NEST
- DBB-81-03 LOCATION AND DESIGNATION OF SOIL BORING
- DBN-89-04A&B SAMPLE LOCATION  
111TCE 3.734.08  
COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND ONE OF SAMPLING (NOV/DEC 1981)  
COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND TWO OF SAMPLING (APR/MAY 1982)  
COMPOUND OF CONCERN

SCALE IN FEET

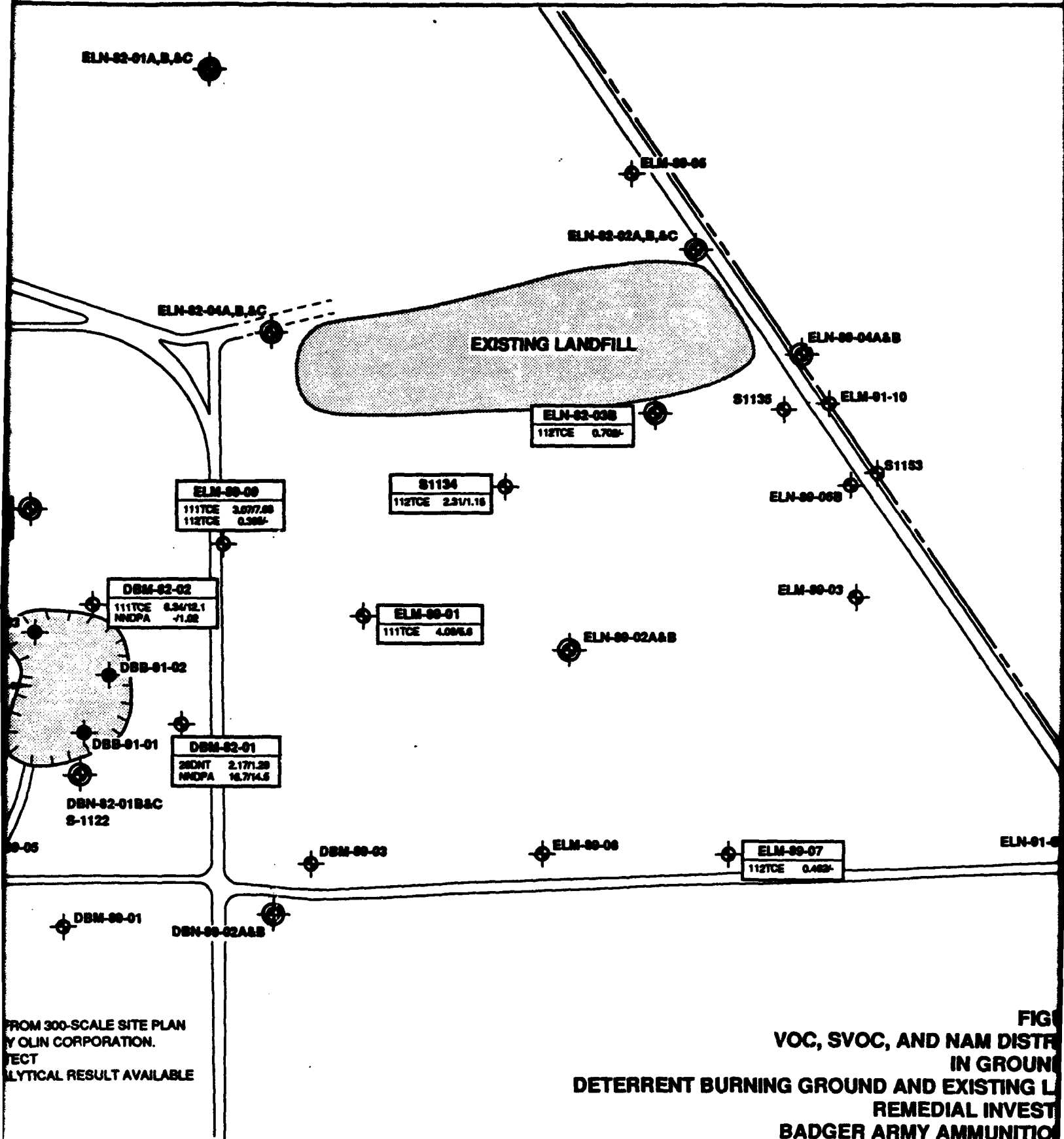


### NOTES:

1. BASE PLAN FROM 300-SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. - = NON-DETECT
3. NR = NO ANALYTICAL RESULT AVAILABLE



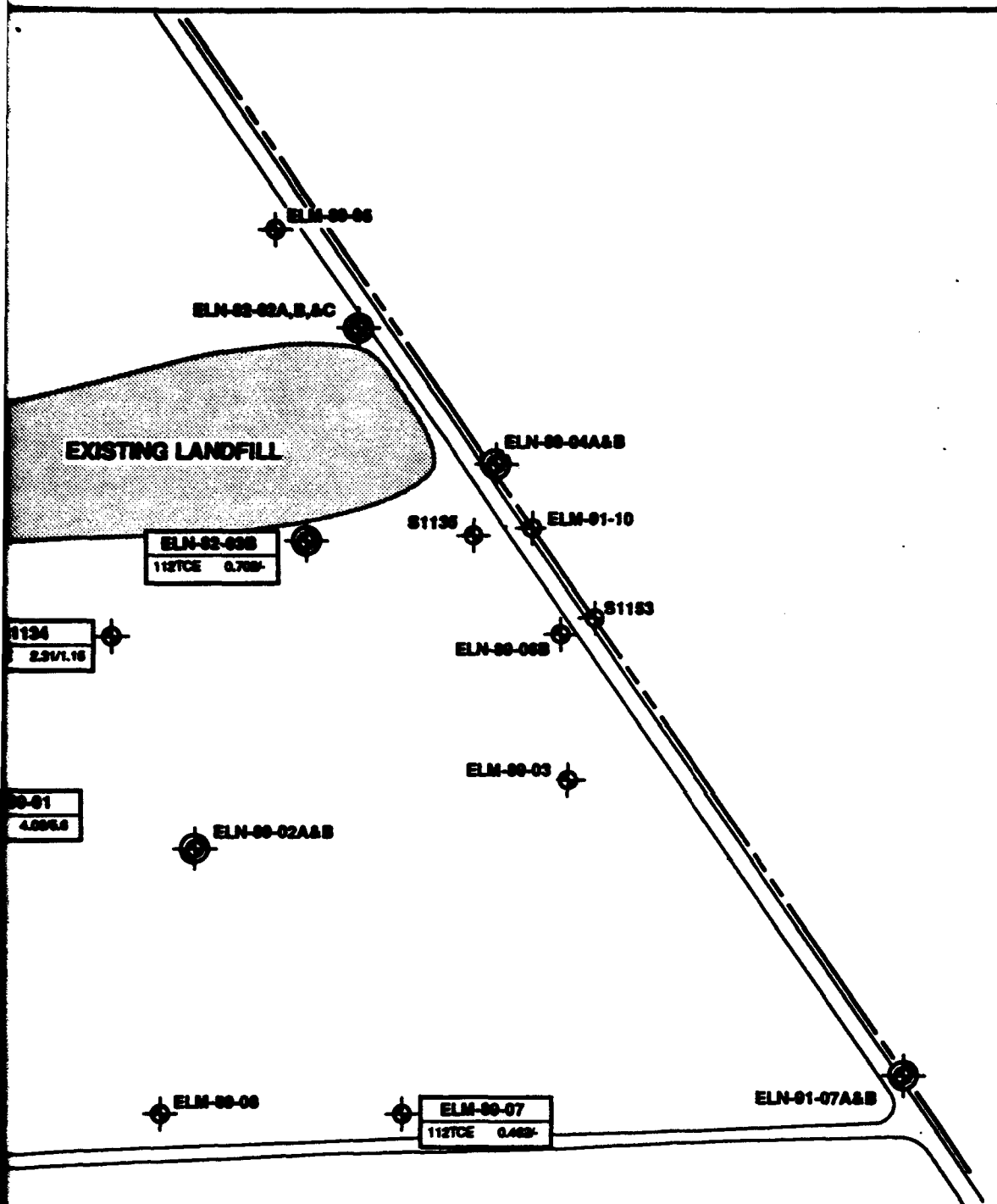
2



**FIG 1**  
**VOC, SVOC, AND NAM DISTRIBUTION**  
**IN GROUND**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**

ABB Environmental Services





**FIGURE 7-22**  
**VOC, SVOC, AND NAM DISTRIBUTION**  
**IN GROUNDWATER**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





S1132

ELN-82-01	A	B	C
CR	10.8	8.48	8.48
PS	+	8.51	8.88

Production  
Well No. 4

ELN-82-04	A	B	C
CR	7.15	48.5	15.4/5.14

DBN-89-04	A	B
CR	8.1	8.84

ELM-89-09
CR 13.8

DBM-82-02
CR 8.88

DETERRENT  
BURNING  
GROUND

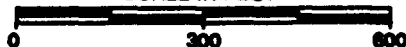
DBM-82-01
CR 8.74

DBN-82-01 & S-1122			
	S-1122	B	C
CR	7.51	+	+

**LEGEND**

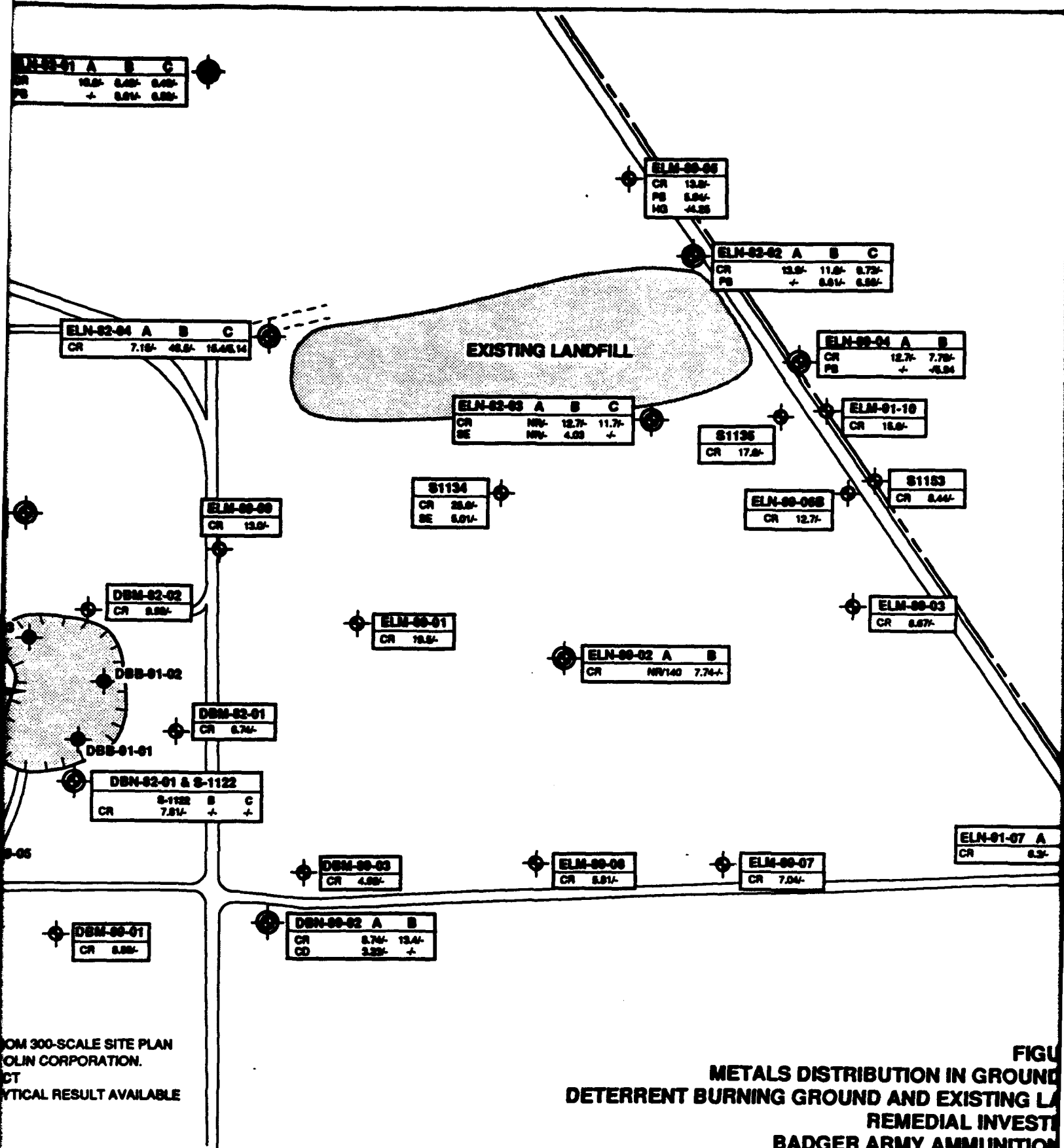
- ELM-89-05 LOCATION AND DESIGNATION OF SINGLE MONITORING WELL
- ELN-82-02A,B,C LOCATION AND DESIGNATION OF MONITORING WELL NEST
- DBB-81-03 LOCATION AND DESIGNATION OF SOIL BORING
- SAMPLE LOCATION  
COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND ONE OF SAMPLING (NOV/DEC 1991)  
COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND TWO OF SAMPLING (APR/MAY 1992)  
COMPOUND OF CONCERN

SCALE IN FEET

**NOTES:**

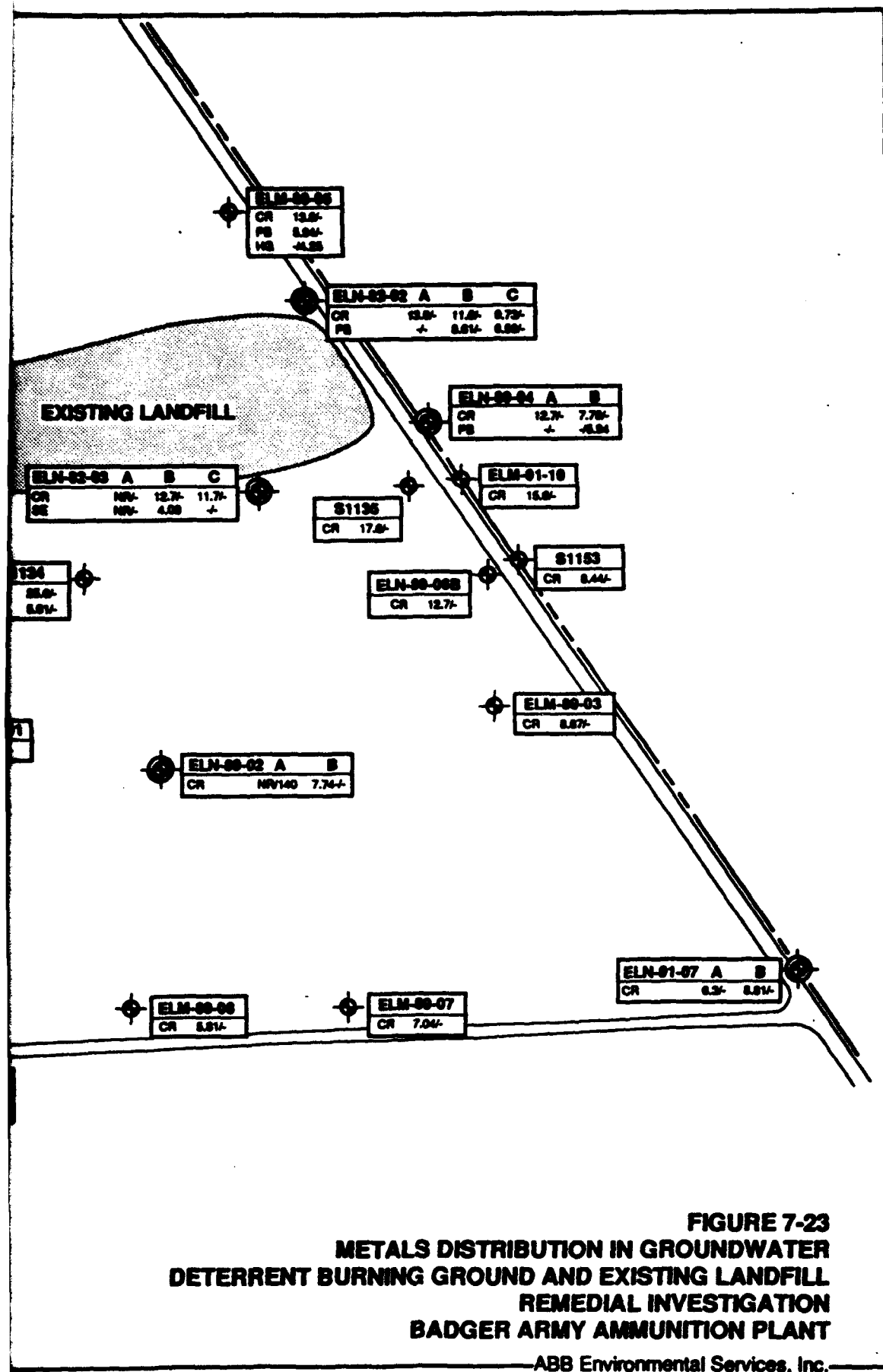
1. BASE PLAN FROM 300-SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. - = NON-DETECT
3. NR = NO ANALYTICAL RESULT AVAILABLE





**FIGURE 1**  
**METALS DISTRIBUTION IN GROUND**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**





**FIGURE 7-23**  
**METALS DISTRIBUTION IN GROUNDWATER**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





01122

ELN-02-01		
A	B	C
34,000	8,000	27,000
33,000	22,000	27,000

Production  
Well No. 4

ELN-02-04		
A	B	C
29,000	28,000	28,000
31,000	27,000	23,000

ELM-00-00	
340,000	330,000

DBM-00-04	
A	B
20,000	25,000
20,000	23,000

DBM-02-02	
480,000	630,000

DETERRENT  
BURNING  
GROUND

DBB-01-03

DBB-01-02

DBB-01-01

DBM-02-01	
30,000	32,000

DBM-02-01/S-1122		
S-1122	B	C
28,000	28,000	32,000
28,000	34,000	33,000

DBM-00-05	
31,000	32,000

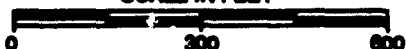
DBM-00-01	
27,000	27,000

**LEGEND**ELM-00-05 LOCATION AND DESIGNATION OF  
SINGLE MONITORING WELLELN-02-02A,B,C LOCATION AND DESIGNATION OF  
MONITORING WELL NESTDBB-01-03 LOCATION AND DESIGNATION OF  
SOIL BORING

DBB-01-01
27,000
27,000

COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND ONE OF SAMPLING (NOV/DEC 1991)  
COMPOUND CONCENTRATION IN SAMPLE ( $\mu\text{g/L}$ )  
FROM ROUND TWO OF SAMPLING (APR/MAY 1992)AREA WITH SO<sub>4</sub> CONCENTRATIONS OVER 125,000  $\mu\text{g/L}$ 

SCALE IN FEET

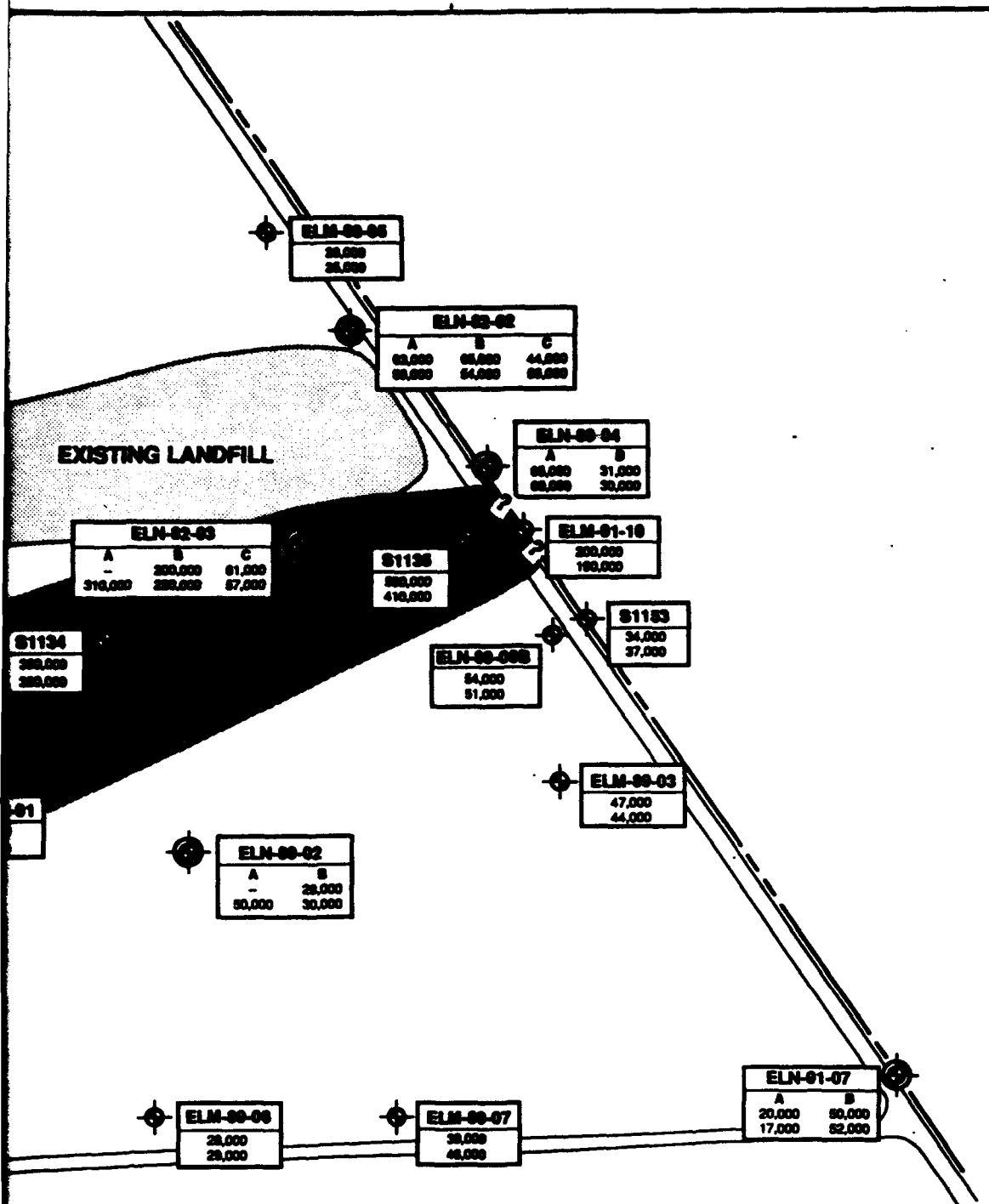
**NOTES:**

1. BASE PLAN FROM 300-SCALE SITE PLAN PROVIDED BY OLIN CORPORATION.
2. - - = NON-DETECT









**FIGURE 7-24**  
**SO4 DISTRIBUTION IN GROUNDWATER**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.





S1122

ELN-82-01		
A	B	C
1,200	970	780
740	880	1,080

Production  
Well No. 4

ELN-82-04		
A	B	C
5,800	3,700	5,700
4,000	1,300	2,400

DBN-88-04	
A	B
6,800	5,800
6,800	9,200

ELN-88-08	
8,300	7,200

DBM-82-02	
4,400	2,300

DETERRENT  
BURNING  
GROUND

DBB-81-03

DBB-81-02

DBM-82-01	
16,000	2,800

DBB-81-01

DBN-82-01/S1122		
S1122	B	C
3,300	2,800	3,800
1,300	1,000	980

DBM-88-05	
6,800	4,200

DBM-88-01	
3,200	2,200

### LEGEND

ELM-88-05 LOCATION AND DESIGNATION OF  
SINGLE MONITORING WELL

ELN-82-02A,B,C LOCATION AND DESIGNATION OF  
MONITORING WELL NEST

DBB-81-03 LOCATION AND DESIGNATION OF  
SOIL BORING

DBN-88-01  
3,200  
2,200  
COMPOUND CONCENTRATION IN SAMPLE (µg/L)  
FROM ROUND ONE OF SAMPLING (NOV/DEC 1991)  
COMPOUND CONCENTRATION IN SAMPLE (µg/L)  
FROM ROUND TWO OF SAMPLING (APR/MAY 1992)

### NOTES:

1. BASE PLAN FROM 300-SCALE SITE PLAN  
PROVIDED BY OLIN CORPORATION.
2. - - NON-DETECT

SCALE IN FEET





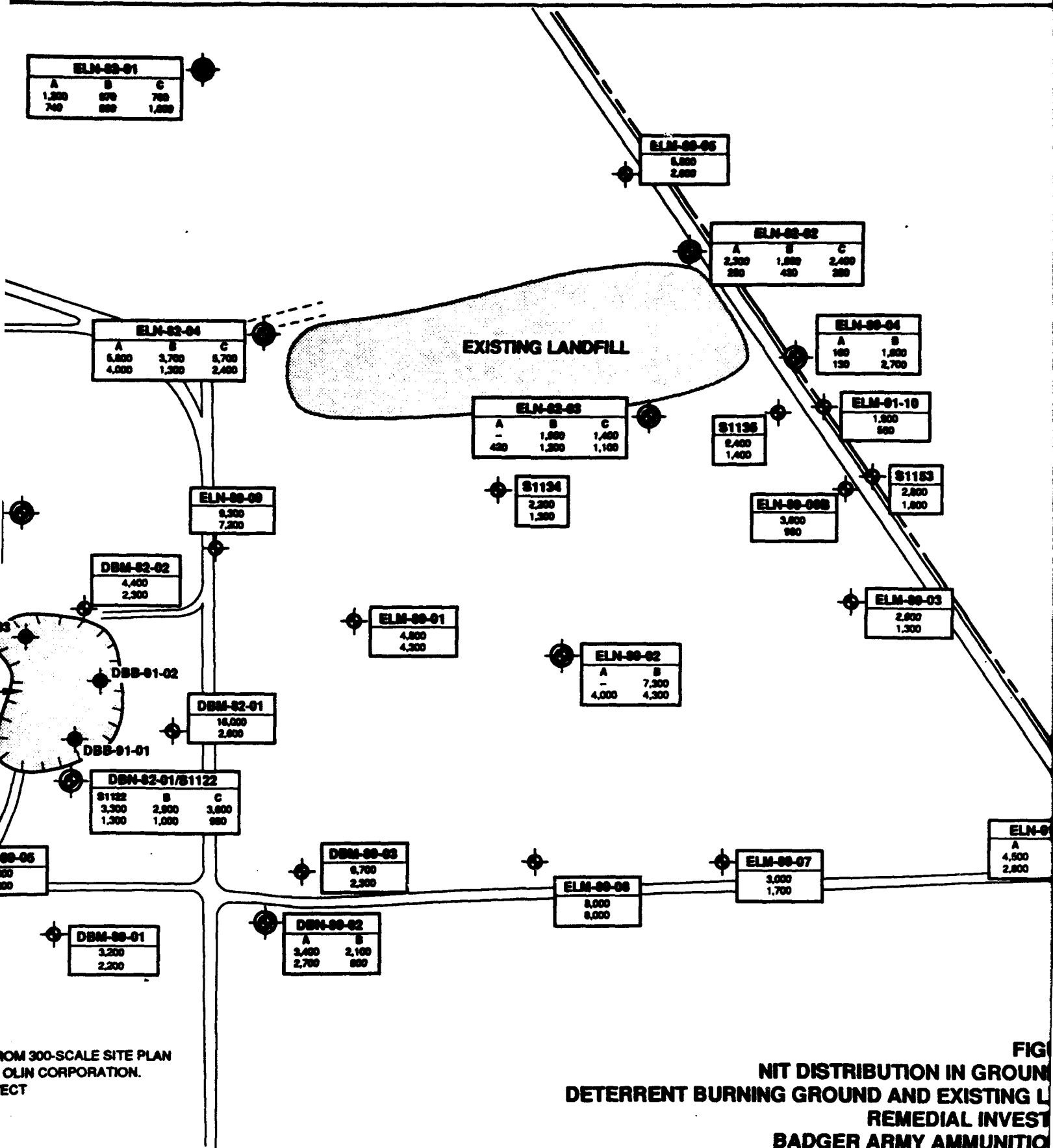
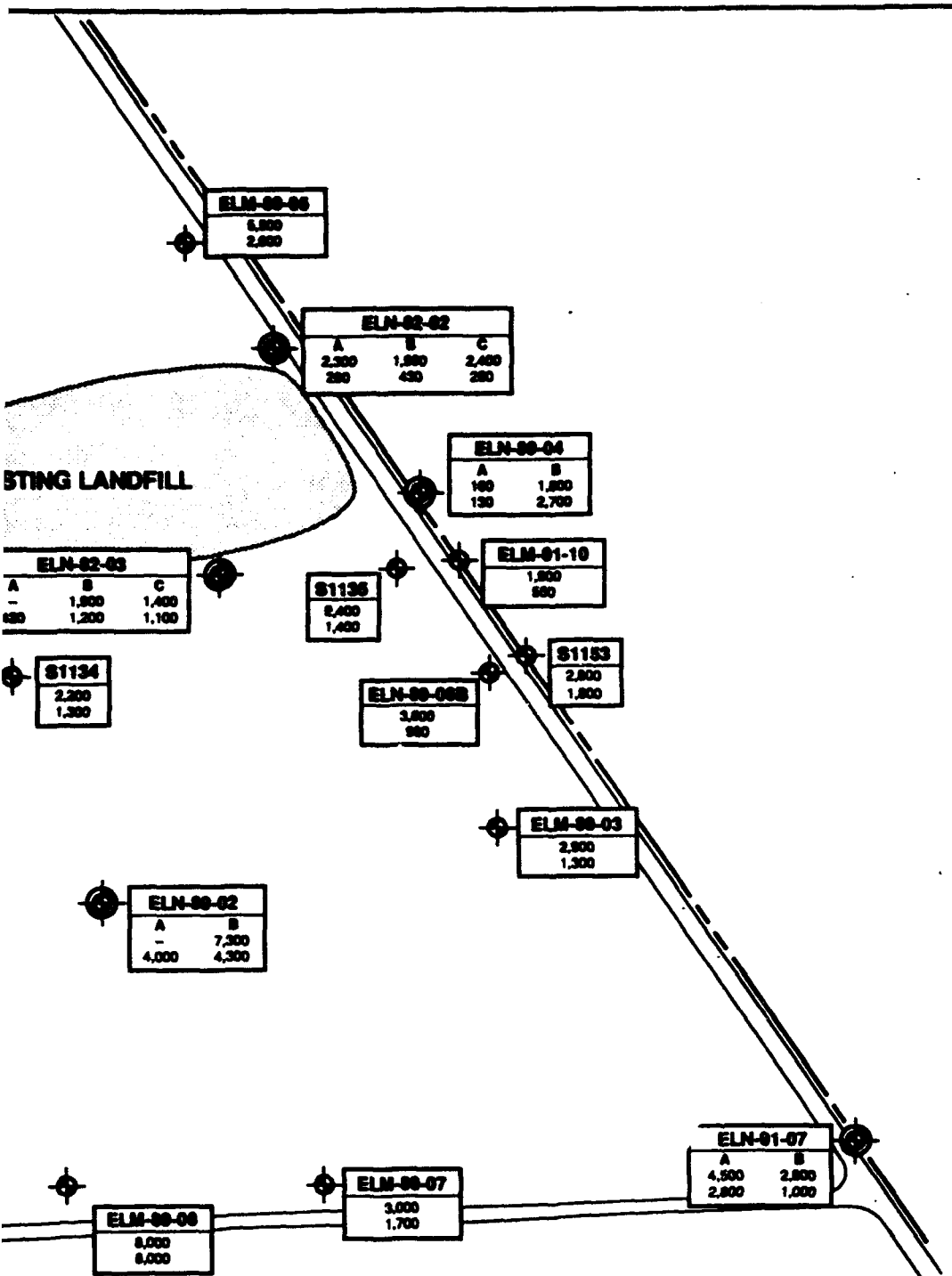


FIGURE 1  
NIT DISTRIBUTION IN GROUND  
DETERRENT BURNING GROUND AND EXISTING LANDFILL  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT





**FIGURE 7-25**  
**NIT DISTRIBUTION IN GROUNDWATER**  
**DETERRENT BURNING GROUND AND EXISTING LANDFILL**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**



**TABLE 8-1**  
**HISTORY OF ACID SPILLS -**  
**NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SPILL DATE</b>	<b>CAUSE</b>	<b>MATERIAL</b>	<b>AMOUNT (TONS)</b>	<b>CONTROL</b>
4/79	Tank leakage	Oleum	47	Diked, neutralized
6/81	Tank overflow	Sulfuric acid	0.4	Diked, neutralized
9/81	Tank seal failure	Nitric acid	0.5	Diked, neutralized
10/81	Tank car leakage	Nitrous acid	7.8	Diked, neutralized
6/82	Tank overflow	Sulfuric acid	27	Diked, neutralized
6/82	Tank leakage	Nitric acid	<4	Diked, neutralized
10/82	Tank leakage	Sulfuric acid	0.4	Diked, neutralized
11/84	Pipe failure	Mixed acids	185	Recovered, diked, neutralized

Source: Tsai et al., 1988.



**TABLE 8-2**  
**SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -**  
**NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	PROGRAM ELEMENTS				
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING	SEDIMENT, SURFACE SOIL, AND SURFACE WATER SAMPLING
Nitroglycerine Pond and Rocket Paste Area	--	--	4 new wells; 20 samples from 4 new and 6 existing wells	--	70 surface soil samples 8 sediment samples 4 surface water samples
New Acid Area	--	--	6 samples from existing wells	--	--

**Notes:**

\* Includes 2 rounds of groundwater sampling



TABLE 8-3  
SUMMARY OF MONITORING WELLS INSTALLED -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
<u>Nitroglycerine Pond</u>						
NPM-89-01	Drill through casing hammer	111	762.5	20	Downgradient and 700 feet south of the Nitroglycerine Pond and the Batch Nitroglycerine Area.	To provide horizontal definition of any potential plumes from the Nitroglycerine Pond and the Batch Nitroglycerine Area.
<u>Rocket Paste Area</u>						
RPM-89-01	Drill through casing hammer	127	761.9	20	Adjacent to the Rocket Area drainage ditch and downgradient of the Rocket Paste Pond.	To characterize water quality at the water table downgradient of the Rocket Paste Pond and adjacent to the Rocket Paste Area drainage ditch.
RPM-89-02	Drill through casing hammer	115	761.2	20	Downgradient and southeast of the Rocket Paste Pond.	To characterize groundwater quality and elevation downgradient and southeast of the Rocket Paste Pond.
RPM-91-01	Dual-wall driven casing	110	766.0	10	Downgradient and east of the Rocket Paste Area.	To assess groundwater quality downgradient of the east Rocket Paste Area.



**TABLE 8-4**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
RPM-89-01 <sup>1</sup>	1.3	$2 \times 10^{-1}$	Medium to coarse sand and medium to coarse gravel (SP-GP)
RPM-89-02	1.7	$1 \times 10^{-1}$	Fine to coarse sand with little gravel (SP)

**Notes:**

Hydraulic Conductivity Tests completed during March and November, 1989, and November and December 1991.

Field data and calculations are presented in Appendix I.

Values for hydraulic conductivities represent an averaged value of multiple tests performed on each well.

- <sup>1</sup> Water level recovery at these wells impacted by inertial effects, resulting in water level recovery above static water levels.  
Hydraulic conductivity measurements may be greater than the calculated values at these wells.

cm/sec = centimeters per second



**TABLE 8-5**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITES</b>	<b>NEW WELLS</b>	<b>EXISTING WELLS</b>
Nitroglycerine Pond and Rocket Paste Area	RPM-89-01 RPM-89-02 RPM-91-01 NPM-89-01	S1118 S1119 S1120 S1124 S1125 S1150
Subtotal	4	6
New Acid Area		NAN-81-01A NAN-81-02B NAN-81-03B,C NAN-81-04B,C
Subtotal	0	6
Magazine Area		S1115 S1116
Subtotal	0	2
Southeastern/Eastern Boundary		S1110 S1111 S1112 S1113 S1114 S1121
Subtotal	0	6
<b>TOTAL WELLS</b>	<b>4</b>	<b>20</b>







SAMPLE LOCATION	INORGANICS													OTHER			ORGANICS				
	TOTAL METALS					TCLP METALS					ANIONS			NH4N2	TOC	pH	VOC	BVA	MG	NAM	DNT
	PP	AL	CA	NA	CD	CR	HG	PB	CD	CR	HG	PB	ANION8								
RPS-01-21	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-22	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-23	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-24	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-25	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-26	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-27	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-28	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-29	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-30	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-31	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-32	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-33	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-34	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-35	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-36	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-37	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-38	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-39	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-40	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-41	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-42	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-43	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-44	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-45	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-46	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-47	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-48	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-49	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-50	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-51	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1
RPS-01-52	-	-	-	-	-	1	1	1	1	1	1	1	1	1	-	-	-	1	1	1	1



TABLE 8-8  
CHEMICAL ANALYSES PERFORMED ON SURFACE SOIL AND SEDIMENT SAMPLES -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	TOTAL METALS										INORGANICS					OTHER					ORGANICS				
	PP	AL	CA	NA	CD	CR	HG	PB	FE	CU	CD	CR	HG	PB	NI	NT	SO <sub>4</sub>	NH <sub>4</sub> N	TOC	pH	VOC	BNA	MG	NAM	DNT
RPS-01-53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RPS-01-68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	0	0	0	0	0	77	77	77	77	77	53	53	53	53	53	67	67	10	0	0	0	0	67	77	67

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SE, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BNA = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography

USA007.wk1



TABLE 8-7  
CHEMICAL ANALYSES PERFORMED ON SURFACE WATER SAMPLES  
NITROGLYCERINE POND/ROCKET PASTE POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS								ORGANICS				
	TAL METAL	NIT	NH3N2	2KJEL	SO4	CL	ALK	HARD	VOC	BNVA	MB	DNT	
NITROGLYCERINE POND													
PW-91-01	1	1	1	1	1	1	1	1	1	1	1	1	
NPW-91-02	1	1	1	1	1	1	1	1	1	1	1	1	
ROCKET PASTE POND													
RPW-91-01	1	1	1	1	1	1	1	1	1	1	1	1	
RPW-91-02	1	1	1	1	1	1	1	1	1	1	1	1	
TOTALS	4	4	4	4	4	4	4	4	4	4	4	4	

NOTES:

BNVA = base-neutral and acid-extractable organics by GC/MS

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

GC/MS = Gas Chromatography/Mass Spectrometry

HPLC = High Performance Liquid Chromatography

NAM = Nitroamines by GC

N2KJEL = Nitrogen by Kjeldahl Method

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SE, TL, ZN)

TAL = Toxic Analyte List (25) (AL, SE, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

USA024 wk1



TABLE 8-8  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS										ANIONS			OTHER				ORGANICS				TPH	
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	VOC	BNVA	HG	NAM		DNT
NITROGLYCERINE POND																							
NPM-88-01	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
S1124	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
ROCKET PASTE AREA																							
RPM-88-01	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B
RPM-88-02	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B
RPM-91-01	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B
S1116	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
S1119	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
S1120	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
S1125	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
S1150	--	--	--	--	B	B	B	B	--	B	B	B	B	B	B	B	--	B	B	--	B	--	--
NEW ACID AREA																							
NAN-81-01 A	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
NAN-81-02 B	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
NAN-81-03 B	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
NAN-81-03 C	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
NAN-81-04 B	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
NAN-81-04 C	--	--	B	B	B	B	--	B	B	B	B	B	B	B	B	B	--	B	--	--	--	--	--
MAGAZINE AREA																							
S1115(1)	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	--	B	--	--	--
S1116	B	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	--	B	--	--	--



TABLE 2-3  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS																	ORGANICS				TPH	
	METALS							ANIONS			OTHER												
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TD8	TOC	NH3N2	VOC	BN/A	MG	NAM		DNT
SOUTHEASTERN/EASTERN BOUNDARY																							
S1110	--	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	--	--	--	--	--	--
S1111	--	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	--	--	--	--	--	--
S1112	--	--	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	--	--	--	--	--	--
S1113	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--
S1114	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	--	--	--	--
S1121	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	2	--	--	--	--

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BN/A = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrobenzene by HPLC

HPLC = High Performance Liquid Chromatography

(1) AG was not analyzed for in Round Two.

B = Analyzed in Both Rounds (One and Two).

2 = Analyzed in Round Two Only.

USA015.wk1



SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	NPS-91-01	NPS-91-02	NPS-91-03	NPS-91-04	NPS-91-05	NPS-91-06	NPS-91-07	NPS-91-08	NPS-91-09	NPS-91-10
Sample Type:	POND	POND	POND	POND	POND	POND	POND	POND	POND	POND
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/20/91	09/20/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/22/91	09/20/91	09/20/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SVOCs</b>										
123PDA	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NG	-	-	-	-	-	-	-	-	9.390	15.800
NNDMEA	-	-	-	-	-	-	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	-	-	-	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
CR	40.500	30.900	30.600	16.300	4.900	20.700	7.000	28.900	39.500	32.100
HG	12.000	20.000	14.000	3.500	0.159	5.100	0.752	14.000	2.400	-
PB	410.000	110.000	270.000	140.000	32.000	190.000	58.000	240.000	2000.000	10000.000
<b>Anions</b>										
NIT	-	-	-	-	-	-	-	-	-	-
SO4	-	-	-	-	-	-	-	-	-	-
<b>Indicator Parameter</b>										
NH3	3.870	6.850	72.500	15.100	2.280	66.700	6.110	22.900	17.700	4.470

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-01	RPS-91-02	RPS-91-03	RPS-91-04	RPS-91-05	RPS-91-06	RPS-91-07	RPS-91-08	RPS-91-09	RPS-91-10
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/20/91	09/20/91	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SVOCs										
123PDA	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DEP	-	2.460	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	-	-	-
NG	1.760	-	-	-	0.729	-	-	-	-	-
NNDMEA	-	-	-	-	-	-	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-	-	-
NNDPA	4.980	0.738	-	-	0.245	-	-	-	-	-
PHANTR	-	-	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-
Metals										
CR	45.700	33.800	4.410	17.400	17.800	15.400	6.220	15.300	13.100	11.800
HG	0.157	0.080	-	-	-	-	-	-	-	-
PB	2600.000	1100.000	470.000	3500.000	24.000	110.000	120.000	9.500	120.000	14.300
Anions										
NIT	2.220	1.960	2.350	4.150	4.860	5.300	3.290	6.550	4.480	3.180
SO4	150.000	210.000	6.280	10.200	-	-	-	6.810	-	-
Indicator										
NH3										
Parameter										

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-11	RPS-91-12	RPS-91-13	RPS-91-14	RPS-91-15	RPS-91-16	RPS-91-17	RPS-91-18	RPS-91-19	RPS-91-20
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91	09/17/91	09/18/91	09/18/91	09/18/91	09/18/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SVOCs</b>										
123PDA	-	24.100	6.200 GT	9.230	-	-	-	-	-	-
24DNT	-	2.120	1.250	6.360	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
B2EHP	1.560	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	0.305	0.322	-	-	-	-	-	-
DEP	6.200 GT	6.200 GT	6.200 GT	5.880	2.980	-	7.550	6.200 GT	-	6.200 GT
FANT	-	-	0.235	0.323	-	-	0.048	0.091	-	-
NG	9.570	130.000	290.000	3.870	-	4.770	-	15.900	-	2.130
NNDMEA	-	-	-	-	-	-	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-	-	-
NNDPA	47.000	260.000	450.000	49.000	2.090	1.940	0.121	0.375	0.538	0.101
PHANTR	-	-	0.115	0.279	-	-	-	0.097	-	-
PYR	-	-	0.252	0.380	-	-	-	-	-	-
<b>Metals</b>										
CR	21.400	12.600	38.700	23.300	15.400	13.700	21.600	19.200	27.800	11.600
HG	-	-	0.067	0.067	0.560	0.054	-	0.069	-	-
PB	1100.000	19.000	170.000	58.000	15.300	190.000	110.000	1400.000	16.000	130.000
Antions	NIT	3.200	9.410	6.670	6.250	1.360	5.530	6.340	3.700	4.090
SO4	-	-	-	-	-	-	7.670	-	8.370	17.100
<b>Indicator</b>										
<b>parameter</b>										
NH3	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-21	RPS-91-22	RPS-91-23	RPS-91-24	RPS-91-25	RPS-91-26	RPS-91-27	RPS-91-28	RPS-91-29	RPS-91-30
Sample Type:	DITCH	DITCH	DITCH	DITCH	DITCH	DITCH	DITCH	DITCH	DITCH	DITCH
DEPTH:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SVOCs										
123PDA	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-
B2EHP	1.610	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBEANT	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	0.189	-	-	-	0.147	-
DEP	-	-	6.200 GT	6.200 GT	6.200 GT	-	6.200 GT	6.29	5.250	6.200 GT
FANT	-	-	0.155	-	0.179	-	-	-	0.111	0.008
NG	-	-	4.840	2.390	3.870	12.100	1.700	0.873	5.820	-
NNDMEA	-	-	-	-	-	-	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-	-	-
NNDPA	-	-	3.470	2.480	1.700	-	36.000	0.167	1.960	2.550
PHANTR	-	-	0.096	0.129	0.119	-	-	-	-	0.056
PYR	-	-	0.223	-	0.221	-	-	-	0.179	-
Metals										
CR	9.920	3.410	20.600	19.600	13.800	6.470	6.620	6.650	16.500	12.400
HG	-	-	-	-	-	-	-	-	-	-
PB	64.000	15.000	580.000	180.000	130.000	22.000	54.000	12.000	110.000	730.000
Ambient										
NIT	2.000	2.200	3.580	8.540	5.380	1.690	4.130	-	4.130	2.950
SO4	-	-	7.520	11.600	11.000	-	-	-	-	-
Indicator Parameter										
NH3	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID	RPS-91-31	RPS-91-31	RPS-91-32	RPS-91-32	RPS-91-32	RPS-91-33	RPS-91-33	RPS-91-34	RPS-91-34	RPS-91-35	RPS-91-35
Sample type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNIT:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91	09/18/91
DEPTH:	0.0m	0.5m	0.7m	0.0m	0.0m	0.5m	0.0m	0.3m	0.0m	0.0m	0.5m
SVOCs											
123PDA	-	-	-	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	-	-	-	-	-
26DNT	-	-	-	-	-	-	-	-	-	-	-
B2HP	-	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	0.173	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-	-
BGHPY	-	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-	-
DEP	6.200 GT	49.800 S	47.100 S	0.652	-	-	6.200 GT	4.980 S	2.050	2.110 S	-
FANT	-	-	-	-	-	-	0.159	-	-	-	-
NG	27.900	-	48.500	1.250	-	-	26.100	-	1.700	-	-
NNDMEA	-	-	-	-	-	-	0.040	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-	-	-	-
NNDPA	1.780	-	3.700	-	-	-	81.000	-	2.460	-	-
PHANTR	-	-	0.102	-	-	-	0.111	-	-	-	-
PYR	-	-	-	-	-	-	-	-	-	-	-
Metals											
CR	5.500	14.700	-	14.600	-	-	31.600	-	66.500	-	-
HG	-	-	-	-	-	-	-	-	-	-	-
PB	42.000	120.000	-	12.600	-	-	75.000	-	150.000	-	-
Arsenic											
Ni1	5.380	2.240	-	2.440	-	-	3.780	-	3.040	-	-
SO4	-	-	-	-	-	-	-	-	-	-	-
Indicator											
Ni13	-	-	-	-	-	-	-	-	-	-	-
Parameter											

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-36	RPS-91-36	RPS-91-36	RPS-91-37	RPS-91-38	RPS-91-39	RPS-91-40
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/18/91	09/18/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91
DEPTH:	0.000	0.500	0.000	0.000	0.000	0.000	0.000
SVOCs							
123PDA	-	-	-	-	93.100	33.200	560.000
24DNT	-	-	-	-	6.200 GT	6.200 GT	23.100
26DNT	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	0.280
BREFANT	-	-	-	-	-	-	2.130
BGHPY	-	-	-	-	-	-	-
CHRY	-	-	-	0.211	-	-	0.865
DEP	-	-	-	-	6.200 GT	1.860	-
FANT	-	-	-	0.164	-	-	1.120
NG	-	-	-	-	310.000	240.000	1400.000
NNDMEA	-	-	-	-	0.150	0.022	0.302
NNDNPA	-	-	-	-	0.230	0.096	0.226
NNDPA	0.092	-	-	0.429	3.590	900.000	10000.000
PHANTR	-	-	-	0.101	0.146	-	-
PYR	-	-	-	0.299	-	-	0.932
Metals							
CR	12.500	-	9.000	-	18.400	15.600	109.000
HG	-	-	-	-	0.161	0.098	0.716
PB	8.500	-	100.000	-	290.000	260.000	2200.000
Anions							
NIT	4.130	-	4.170	-	4.840	3.330	120.000
SO4	-	-	-	-	-	-	7.560
Indicator parameter							
NH3	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-41	RPS-91-42	RPS-91-43	RPS-91-44	RPS-91-45	RPS-91-46	RPS-91-47	RPS-91-48	RPS-91-49	RPS-91-50
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SVOCs										
123PDA										
24DNT	3.950	-	-	-	-	-	-	8.340	3.150	810.000
26DNT	-	-	-	-	-	-	-	0.790	-	32.500
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	-	-	-	-	-	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-	-	-
BGHIPY	-	-	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	-	1.860	0.901	6.200 Gf
NG	4.330	-	-	-	-	-	-	-	-	0.118
NNDMEA	-	-	-	-	-	-	1.120 N	23.300	27.200	1500.000
NNDNPA	-	-	-	-	-	-	-	-	-	0.123
NNDPA	59.000	3.920	1.770	0.345	1.050	1.060	2.950	250.000	120.000	0.160
PHANTR	-	-	-	-	-	-	-	-	-	2600.000
PYR	-	-	-	-	-	-	-	-	-	0.197
Metals										
CR	12.500	14.600	6.400	24.800	3.730	10.300	13.200	26.000	23.500	39.600
HG	0.083	-	-	0.055	-	-	0.061	-	0.071	0.212
PB	78.000	21.000	20.000	40.000	160.000	43.000	32.000	32.000	78.000	140.000
Antiox										
NIT	7.190	9.110	4.890	7.140	4.960	2.680	12.500	2.660	12.700	6.110
SO4	-	-	-	-	-	-	17.800	-	16.200	-
Indicator parameter										
NH3										

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-51	RPS-91-52	RPS-91-53	RPS-91-54	RPS-91-55	RPS-91-56	RPS-91-57	RPS-91-58	RPS-91-59	RPS-91-60
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/19/91	09/20/91	09/20/91	09/20/91	09/20/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>SVOCs</b>										
123PDA										
24DNT	86.300	-	-	-	-	-	-	-	-	-
26DNT	6.530	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-
BAANTR	0.666	-	-	-	-	-	-	-	-	-
BBFANT	2.030	-	-	-	-	-	-	-	-	-
BGHPY	1.910	-	-	-	-	-	-	-	-	-
CHRY	1.000	-	-	-	-	-	-	-	-	-
DEP	2.510	-	-	-	-	-	-	-	-	-
FANT	0.274	-	-	-	-	-	-	-	-	-
NG	7.550	1.210 N	3.300	9.500	6.200 GT	1.650	-	6.200 GT	-	0.083
NNDMEA	0.059	-	-	-	0.058	0.050	0.059	-	-	2.190
NNDNPA	0.127	-	-	-	48.200	2.170 N	1.840	31.500	0.023	-
NNDPA	2400.000	1.350	13.000	240.000	19.000	1.420	0.467	3.910	-	12.000
PHANTR	0.231	-	-	-	0.076	-	-	-	-	-
PYR	0.683	-	-	-	-	-	-	-	-	-
<b>Metals</b>										
CR	30.800	7.040	7.100	13.800	35.500	19.900	19.300	9.760	16.000	19.900
HG	0.134	-	0.060	-	-	0.056	-	-	0.117	-
PB	490.000	15.000	35.000	29.000	140.000	100.000	55.000	40.000	52.000	57.000
<b>Anions</b>										
NIT	7.040	2.750	3.780	9.460	6.000	3.650	3.930	4.730	7.550	7.320
SO4	6.390	8.020	6.210	-	-	-	-	-	-	-
<b>Indicator parameter</b>										
NH3										

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SURFACE SOIL AND SEDIMENT CHEMICAL DATA -  
NITROGLYCERINE POND/ ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	RPS-91-61	RPS-91-62	RPS-91-63	RPS-91-64	RPS-91-65	RPS-91-66	RPS-91-67	RPS-91-68
Sample Type:	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH	DTCH
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	09/20/91	09/20/91	09/20/91	09/20/91	09/20/91	09/20/91	09/20/91	09/20/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SVOCs								
12PDA	-	-	-	-	-	-	-	-
24DNT	-	-	-	-	-	-	6.850	-
26DNT	-	-	-	-	-	-	0.783	-
B2EHP	-	-	-	-	-	-	-	-
BAANTR	-	-	0.193	-	-	-	-	-
BBFANT	-	-	-	-	-	-	-	-
BGHIPI	-	-	-	-	-	-	-	-
CHRY	-	-	-	-	-	-	-	-
DEP	-	-	-	-	-	-	-	-
FANT	-	-	-	-	-	-	0.046	-
NG	0.709	-	-	1.540	-	-	-	-
NNDMEA	-	-	-	-	-	-	-	-
NNDNPA	-	-	-	-	-	-	-	-
NNDPA	3.370	-	0.476	86.000	0.138	1.370	200.000	0.129
PHANTR	-	-	-	-	-	-	-	-
PYR	-	-	-	-	-	-	-	-
Metals								
CR	10.700	15.500	21.100	20.900	7.730	8.620	10.800	10.400
HG	-	-	-	-	-	-	-	-
PB	34.000	29.000	44.000	32.000	19.000	27.000	72.000	19.000
Anions								
NIIT	6.950	4.170	3.560	9.690	8.460	6.120	4.100	2.910
SO4	-	-	-	12.800	22.900	-	-	-
Indicator parameter								
NIH3	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 8-9  
SUMMARY OF SOIL AND SEDIMENT CHEMICAL DATA-  
NITROGLYCERINE POND/ ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOCs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
.	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Flagged results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results.

USATHAMA chemical codes are defined in the RJ Report Glossary



TABLE 8-10  
SUMMARY OF SURFACE WATER CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	NPW-91-01	NPW-91-02	RPW-91-01	RPW-91-02
Sample Type:	POND	POND	POND	POND
UNITS:	UCL	UCL	UCL	UCL
DATE SAMPLED:	09/22/91	09/22/91	09/20/91	09/20/91
DEPTH:	0.000	0.000	0.000	0.000
SVOCs	N2KJEL NH3N2	1800.000 63.400	3100.000 147.000	2600.000 33.800
Metals	AL	3020.000	2140.000	5410.000
	AS	5.430	4.980	8.600
	BA	47.300	63.100	121.000
	BE	-	-	-
	CA	11700.000	15200.000	30800.000
	CR	-	-	-
	CU	-	-	21.300
	FE	3970.000	2920.000	7980.000
	HG	0.325	0.324	-
	K	12800.000	15000.000	43000.000
	MG	5340.000	5880.000	14900.000
	MN	81.700	207.000	152.000
	NA	7790.000	8320.000	1190.000
	PB	41.200	45.900	910.000
	V	8.370	6.620	22.300
	ZN	-	-	34.900
Anions	CL	1680.000	1930.000	2700.000
	NIT	-	-	10.500
	SO4	4070.000	4470.000	32000.000
Indicator	ALK	116000	78100	128000
parameter	HARD	58200	54100	491000
				129000

Notes and flagging codes are presented at the end of this table.



TABLE 8-10  
SUMMARY OF SURFACE WATER CHEMICAL DATA  
NITROGLYCERINE POND/ ROCKET PASTE AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	-	unitless
(2)	-	Specific conductivity, umhos/cm
UGL	-	Micrograms per liter (parts per billion)
VOCs	-	Volatile organic compounds
SVOGs	-	Semi-volatile organic compounds
Blank cell	-	No analysis performed
.	-	Less than the Certified Reporting Limit (CRL)
GT	-	Greater than the reported value
B	-	Analyte found in blank as well as sample
G	-	Reported results affected by interferences or high background
P	-	Results less than CRL, but greater than Criteria of Detection
R	-	Analyte required for reporting purposes, but not currently certified
S	-	Results based on internal standard
T	-	Uncertified analyte in a certified method
X	-	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results

USATHAMA chemical codes are defined in the RI Report Glossary



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	NPM-89-01			RPM-89-01			RPM-89-02			RPM-91-01		
Sample Type:	WELL			WELL			WELL			WELL		
UNITS:	UGL			UGL			UGL			UGL		
DATE SAMPLED:	11/25/91	04/14/92	12/12/91	04/15/92	12/12/91	04/21/92	12/12/91	04/21/92	12/12/91	04/22/92		
ROUND:	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO	ONE	TWO		
VOCs												
13DMB	-	-	-	-	-	-	-	-	-	-	-	-
ACET	-	-	-	-	-	-	-	-	-	-	-	-
CCl4	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	-	6.76 B	4.02 P	4.12 P	4.9 P	5.78 B	4.71 P	5.69 B	4.71 P	5.69 B		
CHCL3	-	-	-	-	-	-	-	-	-	-	1.51	
DEETH	-	-	-	-	-	-	-	-	-	-	-	-
MEC6H5	-	-	-	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-	-	-	-	-	-	-
TRIMBZ	-	-	-	-	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-	-	-	-	-
Metals												
CA	-	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-	-
CR	9.52	-	6.31	-	-	-	-	-	-	-	-	-
CU	-	-	-	-	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-	-	-
NI	-	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-	-
V	-	-	-	-	-	-	-	-	-	-	-	-
ZN	-	-	-	-	-	-	-	-	-	-	-	-
Anions												
NIT	2400	1900	3100	1600	2600	1900	2600	1900	2600	4100		
CL	25000 X	25000 P	14000	15000	26000 P	26000 P	26000 P	26000 P	26000 P	7600		
SO4	36000	36000	38000	37000	38000	37000	38000	37000	38000	32000		
ALK	278000	284000	209000	270000	272000	293000	327000	327000	327000	315000		
HARD	330000	330000	302000	310000	324000	345000	360000	360000	360000	373000		
NH3	-	-	-	-	-	-	-	-	-	-		
TDS	302000	357000	375000	304000	360000	384000	413000	413000	413000	381000		
pH(1)	7.0	7.6	7.6	7.6	8.2	7.5	7.5	7.5	7.5	7.5		
Sp Cond (2)	673	585	484	638	652	597	570	570	570	585		

Notes and flagging codes are presented at the end of this table.



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	NAN-81-01A	NAN-81-02B	NAN-81-03B	NAN-81-03C	NAN-81-04B
Sample type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/11/91	04/12/92	12/11/91	04/13/92	12/11/91
ROUND:	ONE	TWO	ONE	TWO	ONE
VOCs					
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	-	-	-	-
CH2CL2	4.120 P	5.490 B	4.310 P	6.86 B	4.9 P
CHCL3	-	-	-	-	-
DEETH	-	-	-	-	-
MEC6H5	-	-	-	-	-
TRCLE	-	-	-	-	-
BZHP	-	-	-	-	-
SVOCs					
TRIMBZ					
BA					
CA	85000	79000	70000	81000	75000
CD	-	-	-	-	-
CR	-	9.120	5.370	-	8.46
CU	-	-	-	-	-
FE	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
NA	-	99000	20000 T	73000	21000 T
NI	-	-	-	19.200	-
PB	-	-	-	-	-
V	-	-	-	-	-
ZN	-	-	-	-	-
Anions					
NIT	7300	8500	4000	10000	5200
CL	24000 P	26000 P	37000	27000 X	23000 P
SO4	64000	81000	100000	45000	81000
Indicator	246000	290000	248000	240000	228000
parameter	330000	348000	402000	284000	290000
NH3					
TDS	384000	411000	507000	531000	388000
pH(1)	7.6	7.5	7.7	7.2	7.7
Sp Cond(2)	639	668	737	731	590

Notes and flagging codes are presented at the end of this table.



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA--  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	NAN-81-04C	S1110	S1111	S1112	S1113
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/11/91	04/22/92	12/12/91	04/22/92	11/23/91
ROUND:	ONE	TWO	ONE	TWO	ONE
VOC's					
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	-	-	-	-	-
CH2CL2	4.61	5.78	B	-	36.3
CHCL3	-	-	-	-	2.84
DEETH	-	30	S	-	0.543
MEC6H5	-	-	-	-	-
TRCLE	-	-	-	-	-
B2EHP	-	-	-	-	-
SVOC's					
TRIMBZ	-	-	-	-	-
Metals					
BA	65000	61000	110	80000	98,000
CA	-	-	-	-	82000
CD	-	-	-	-	-
CR	-	-	-	-	9.2
CU	-	-	-	-	-
FE	-	-	-	-	4.69
K	-	-	-	-	-
MG	-	-	-	-	2200
NA	18000	12000	T	2200	T
NI	-	-	-	42000	41000
PB	-	-	-	2720	T
V	-	-	-	-	-
ZN	-	-	-	5.42	12.5
Antions					
NIT	2500	1800	1100	3700	148
CL	14000	14000	3200	3400	2700
SO4	51000	15000	P	25000	X
Indicator	192000	31000	18000	28000	14000
parameter	274000	268000	331000	305000	307000
NH3	273000	324000	308000	362000	354000
TDS	291000	359000	344000	383000	344000
pH(1)	7.8	7.4	7.3	7.7	7.4
SpCond(2)	470	455	384	514	559
				578	624

Notes and flagging codes are presented at the end of this table.



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1114	S1115	S1116	S1118	S1119
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	11/23/91	11/24/91	11/24/91	04/22/92	04/21/92
ROUND:	ONE	ONE	ONE	TWO	TWO
VOCs					
13DMB	-	-	-	-	-
ACET	-	-	-	-	-
CCL4	3.630	-	-	-	7.5 S
CH2CL2	3.620	-	-	-	-
CHCL3	0.835	4.61	4.61	7.84 B	4.8 P
DEETH	-	-	-	0.594 P	-
MEC6H5	-	-	-	-	-
TRCLE	0.531	-	-	-	-
B2EHP	145	-	-	-	-
SVOCs					
TRIMBZ					
BA	24.8	-	-	-	-
CA	61000	-	-	-	-
CD	-	11.9	11	6.85	6.51
CR	7.55	-	-	-	-
CU	-	4.790	-	-	-
FE	136	-	-	-	-
K	1040	-	-	-	-
MG	34000	-	-	-	-
NA	2350	-	-	-	-
NI	-	-	-	-	-
PB	-	-	-	-	-
V	5.25	-	-	-	-
ZN	26	89	197	-	7.46
Anions					
NIT	3400	5000	3800	8000	3500
CL	6300	14000	31000	19000	18000
SO4	20000	17000	28000	51000	37000
Indicator					
ALK	241000	240000	262000	261000	258000
HARD	278000	282000	328000	342000	322000
NH3	-	-	-	-	-
TDS	269000	320000	371000	401000	345000
pH(1)	7.8	7.7	7.1	7.6	7.6
Sp Cond.(2)	437	430	593	545	628

Notes and flagging codes are presented at the end of this table.



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1120	S1121	S1124	S1125	S1150
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/08/91	12/09/91	12/09/91	12/10/91	04/14/92
ROUTINE:	ONE	ONE	ONE	ONE	TWO
	04/25/92	04/13/92	04/14/92	04/14/92	04/14/92
	TWO	TWO	TWO	TWO	TWO
VOCs					
13DMB	6.1 S	4.7 S	6.8 S	-	-
ACET	-	-	-	-	14.0 S
CCL4	-	-	-	-	-
CH2CL2	5.0 P	5.49 B	5.2 P	4.61 P	4.61 P
CHCL3	-	-	-	-	0.634 P
DEETH	-	-	-	-	-
MEC6H5	-	-	5.19 P	-	-
TRCLE	-	-	-	-	-
B2EHP	-	-	-	-	-
SVOCs					
TRIMBZ	20 S	28.3	7.0 S	-	-
Metals					
BA	-	67000	30.9	-	-
CA	-	-	80000	-	-
CD	-	-	-	-	-
CR	7.26	-	7.73	5.5	6.16
CU	-	-	-	-	-
FE	-	28.8	4.76	-	-
K	-	28.4	-	-	-
MG	-	1140 T	1390 T	-	-
NA	-	39000	43000	-	-
NI	-	25000 T	25000 T	-	-
PB	-	-	-	-	-
V	-	-	9.18	-	-
ZN	-	-	-	-	-
Anions					
NIT	3100	2600	5700	4600	4000
CL	9400	63000	20000	3800	27000 X
SO4	27000	10000	21000	25000	36000
Indicator	296000	278000	469000	294000	232000
parameter	864000	338000	438000	244000	304000
HAARD	316000	366000	451000	278000	314000
NH3	88	-	-	-	55.5
TDS	300000	375000	496000	313000	387000
pH(1)	7.7	8.3	7.8	8.4	7.4
pH(2)	7.7	7.7	7.5	7.7	6.5
Sp Cond(2)	532	740	849	557	633
	488	676	802	481	506

Notes and flagging codes are presented at the end of this table.



TABLE 8-11  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
NITROGLYCERINE POND/ ROCKET PASTE AREA/ NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
-	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results

USATHAMA chemical codes are defined in the RI Report Glossary



TABLE 8-12  
TCLP METALS DATA SUMMARY  
CONCENTRATION IN SEDIMENT -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

TCLP LEACHATE CONCENTRATION ( $\mu\text{g/l}$ )				
SAMPLE LOCATION	CD	CR	PB	HG
TCLP RL <sup>1</sup>	1,000	5,000	5,000	200
Minimum Reporting Value	6.8	16.8	43.4	0.1
NPS-89-01	NT	NT	NT	LT
NPS-89-02	NT	NT	NT	0.3
NPS-89-03	NT	NT	NT	LT
NPS-89-04	NT	NT	NT	LT
NPS-89-05	NT	NT	NT	LT
NPS-89-06	NT	NT	NT	LT
NPS-89-07	NT	NT	NT	LT
NPS-89-08	NT	NT	NT	LT
NPS-89-09	NT	NT	NT	LT
NPS-89-10	NT	NT	NT	LT
RPS-90-01	LT	LT	4,378	NT
RPS-90-02	LT	LT	3,806	NT
RPS-90-03	LT	LT	26,480	NT
RPS-90-04	LT	LT	427	NT
RPS-90-05	LT	LT	NT	NT
RPS-90-06	LT	LT	1,011	NT
RPS-90-07	LT	LT	728	NT
RPS-90-08	LT	LT	NT	NT
RPS-90-09	LT	LT	368	NT
RPS-90-10	8	LT	7,449	NT
RPS-90-11	LT	LT	541	NT
RPS-90-12	LT	LT	4,755	NT
RPS-90-13	LT	LT	1,081	NT
RPS-90-14	LT	LT	NT	NT
RPS-90-15	LT	LT	NT	NT
RPS-90-16	LT	LT	21	NT
RPS-91-17	LT	LT	5	LT



continued

**TABLE 8-12**  
**TCLP METALS DATA SUMMARY**  
**CONCENTRATION IN SEDIMENT -**  
**NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

TCLP LEACHATE CONCENTRATION ( $\mu\text{g}/\text{l}$ )				
SAMPLE LOCATION	CD	CR	PB	HG
TCLP RL <sup>1</sup>	1,000	5,000	5,000	200
RPS-91-18	LT	LT	1,660	LT
RPS-91-19	LT	LT	LT	LT
RPS-91-20	LT	LT	517	LT
RPS-91-21	LT	LT	90	LT
RPS-91-22	LT	LT	LT	LT
RPS-91-23	LT	LT	427	LT
RPS-91-24	LT	LT	256	LT
RPS-91-25	LT	LT	242	LT
RPS-91-26	LT	LT	111	LT
RPS-91-27	LT	LT	170	LT
RPS-91-28	LT	LT	91	LT
RPS-91-29	LT	LT	LT	LT
RPS-91-30	LT	LT	968	LT
RPS-91-31	LT	LT	3,860	LT
RPS-91-32	LT	LT	152	LT
RPS-91-33	LT	LT	LT	LT
RPS-91-34	LT	LT	LT	LT
RPS-91-35	LT	LT	92	LT
RPS-91-36	LT	LT	LT	LT
RPS-91-37	LT	LT	LT	0.1
RPS-91-38	LT	LT	427	LT
RPS-91-39	LT	LT	136	LT
RPS-91-40	7.7	LT	305	0.2
RPS-91-41	LT	LT	LT	LT
RPS-91-42	LT	LT	LT	LT
RPS-91-43	LT	LT	LT	LT



continued

**TABLE 8-12**  
**TCLP METALS DATA SUMMARY**  
**CONCENTRATION IN SEDIMENT -**  
**NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SAMPLE LOCATION	TCLP LEACHATE CONCENTRATION ( $\mu\text{g}/\text{L}$ )			
	CD	CR	PB	HG
TCLP RL <sup>1</sup>	1,000	5,000	5,000	200
RPS-91-44	LT	LT	LT	LT
RPS-91-45	LT	LT	LT	LT
RPS-91-46	LT	LT	LT	LT
RPS-91-47	LT	LT	LT	LT
RPS-91-48	LT	LT	LT	LT
RPS-91-49	LT	LT	LT	LT
RPS-91-50	LT	LT	LT	LT
RPS-91-51	LT	LT	95	LT
RPS-91-52	LT	LT	LT	LT
RPS-91-53	LT	LT	LT	LT
RPS-91-54	LT	LT	LT	LT
RPS-91-55	LT	LT	LT	0.1
RPS-91-56	LT	LT	LT	LT
RPS-91-57	LT	LT	LT	LT
RPS-91-58	LT	LT	LT	LT
RPS-91-59	LT	LT	LT	LT
RPS-91-60	LT	LT	LT	LT
RPS-91-61	LT	LT	LT	LT
RPS-91-62	LT	LT	LT	LT
RPS-91-63	LT	LT	LT	LT
RPS-91-64	LT	LT	LT	LT
RPS-91-65	LT	LT	LT	LT



continued

TABLE 8-12  
TCLP METALS DATA SUMMARY  
CONCENTRATION IN SEDIMENT -  
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

TCLP LEACHATE CONCENTRATION ( $\mu\text{g}/\text{l}$ )				
SAMPLE LOCATION	CD	CR	PB	HG
TCLP RL <sup>1</sup>	1,000	5,000	5,000	200
RPS-91-66	LT	LT	LT	LT
RPS-91-67	LT	LT	LT	0.1
RPS-91-68	LT	25	LT	LT

Notes:

<sup>1</sup> TCLP Regulatory Levels (RLs) exist for the following metals: AS, BA, CD, CR, SE, PB, HG, and AG. However, these results were reported only for CD, CR, PB, and HG. (List of USATHAMA Chemical Codes for definitions of chemical abbreviations).

NT = Not tested  
LT = Less than TCLP RL



TABLE 8-13  
COMPOUNDS OF POTENTIAL CONCERN  
NITROGLYCERINE POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF CONCERN	EXPOSURE POINT CONCENTRATION		
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	POND SEDIMENT <sup>2</sup> ( $\mu\text{g/g}$ )	SURFACE WATER <sup>3</sup> ( $\text{mg/l}$ )
AL	--	--	3.02
AS	--	--	0.00543
BA	--	--	0.0631
CL	--	--	1.93
CR	--	40.5	--
HG	2.4	20	0.000325
MN	--	--	0.207
NG	15.8	--	--
NH3	17.7	72.5	--
NH3N2	--	--	0.147
PB	10,000	410	0.0459
SO4	--	--	4.47
V	--	--	0.00837

Notes:

-- = Not identified as a compound of potential concern

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm)

$\text{mg/l}$  = milligram per liter

<sup>1</sup> Assessment of surface soil contamination was performed using samples from NPS-91-09 and NPS-91-10.

<sup>2</sup> Assessment of sediment contamination was performed using samples from NPS-91-01 through NPS-91-08.

<sup>3</sup> Assessment of surface water contamination was performed using samples NPW-91-01 and NPW-91-02.



**TABLE 8-14**  
**SUMMARY OF RISK ESTIMATES**  
**NITROGLYCERINE POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Current and Future Grounds Maintenance Worker	Soil Ingestion	ND	0.008
	Inhalation of Particulates and Volatiles	<u>ND</u>	<u>0.000008</u>
Total		ND	0.008
Future Residential	Soil Ingestion	ND	0.1
Future Child Playing	Ingestion of Sediment	ND	0.03
	Ingestion of Surface Water	$4 \times 10^{-8}$	0.0006
	Dermal Contact with Surface Water	<u><math>4 \times 10^{-8}</math></u>	<u>0.0006</u>
Total for Child Playing		$8 \times 10^{-8}$	0.0312

**Notes:**

ND = Not determined - cancer slope factors not available for compounds of potential concern.



TABLE 8-15  
COMPOUNDS OF POTENTIAL CONCERN  
ROCKET PASTE AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF CONCERN	EXPOSURE POINT CONCENTRATION		
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	POND SEDIMENT <sup>2</sup> ( $\mu\text{g/g}$ )	SURFACE WATER <sup>3</sup> ( $\text{mg/l}$ )
24DNT	8.0	--	--
26DNT	32.5	--	--
BAANTR	0.666	--	--
BBFANT	2.13	--	--
BGHIPIY	1.91	--	--
CHRY	1	--	--
DEP	49.8	2.46	--
FANT	1.12	--	--
NG	1,500	1.76	--
NNDMEA	0.302	--	--
NNDNPA	0.23	--	--
NNDPA	10,000	4.98	--
PHANTR	0.279	--	--
PYR	0.932	--	--
AL	--	--	3.14
AS	--	--	0.015
BA	--	--	0.29
BE	--	--	0.00219
CL	--	--	2.73
CR	109	45.7	0.0595
CU	--	--	0.0791
HG	0.716	0.157	--
MN	--	--	0.503
NH3N2	--	--	0.0634
NI	--	--	0.0407



continued

TABLE 8-15  
COMPOUNDS OF POTENTIAL CONCERN  
ROCKET PASTE AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF CONCERN	EXPOSURE POINT CONCENTRATION		
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	POND SEDIMENT <sup>2</sup> ( $\mu\text{g/g}$ )	SURFACE WATER <sup>3</sup> ( $\text{mg/l}$ )
NIT	120	2.22	0.0105
PB	3,500	2,600	3.1
SO <sub>4</sub>	22.9	210	35
V	--	--	0.0571
ZN	--	--	0.151

Notes:

-- = Not identified as a compound of potential concern

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm)

$\text{mg/l}$  = milligrams per liter

<sup>1</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from RPS-91-03 through RPS-91-68.

<sup>2</sup> Assessment of sediment contamination was performed using samples from RPS-91-01 and RPS-91-02.

<sup>3</sup> Assessment of surface water contamination was performed using samples RPW-91-01 and RPW-91-02.



**TABLE 8-16**  
**SUMMARY OF RISK ESTIMATES**  
**ROCKET PASTE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Current and Future Grounds Maintenance Worker	Soil Ingestion	$2 \times 10^{-5}$	0.04
	Inhalation of Particulates and Volatiles	<u><math>7 \times 10^{-9}</math></u>	<u>ND</u>
	Total for Grounds Maintenance Worker	$2 \times 10^{-5}$	0.04
Future Residential	Soil Ingestion	$1 \times 10^{-3}$	6.0
Future Child Playing	Ingestion of Sediment	$1 \times 10^{-9}$	0.003
	Ingestion of Surface Water	$1 \times 10^{-7}$	0.002
	Dermal Contact with Surface Water	<u><math>1 \times 10^{-7}</math></u>	<u>0.002</u>
	Total for Child Playing	$2 \times 10^{-7}$	0.007

**Notes:**

ND = Not determined - no toxicity factors available for compounds of potential concern.



TABLE 8-17  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g/l}$   
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
BA	6:6	110	24.4	2,000	2,000	1,000(c)	200(c)	-
CD	2:42	3.41	3.29	5	5	10(d)	1(d)	-
CHCL3	5:42	1.51	0.543	-	-	6	0.6	-
CL	48:48	89,000	3,200	250,000(a)	-	250,000(e)	125,000(e)	-
CR	19:42	11.9	4.71	100	100	50(f)	5(f)	-
CU	4:10	17.4	4.69	TT	1,300	-	-	-
NA	16:18	99,000	2,350	20,000(b)	-	-	-	-
NIT	48:48	11,000	810	10,000	10,000	10,000	2,000	-
PB	4:42	17	7.46	TT	0	50(g)	5(g)	-
SO4	48:48	150,000	10,000	250,000(a)	-	-	-	-
TRCLE	1:42	0.531	-	5	0	5	0.18	-



continued

TABLE 8-17  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g}/\text{t}$   
NITROGLYCERINE POND/ROCKET PASTE AREA/NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
V	5:6	17.8	5.25	-	-	-	-	260
ZN	4:10	197	26.1	5,000(a)	-	5,000(e)	2,500(e)	7,300

Sources:

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards," Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of  $10^{-6}$  or HI of 1 (see Subsection 4.5 for details).

Notes:

- (a) Secondary drinking water standard, suggested level.
- (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
- (c) WI proposing change to ES = 2,000  $\mu\text{g}/\text{t}$  and PAL = 400  $\mu\text{g}/\text{t}$
- (d) WI proposing change to ES = 5  $\mu\text{g}/\text{t}$  and PAL = 0.5  $\mu\text{g}/\text{t}$
- (e) Value for protection of public welfare (usually aesthetic concerns) rather than protection of public health.
- (f) WI proposing change to ES = 100  $\mu\text{g}/\text{t}$  and PAL = 10  $\mu\text{g}/\text{t}$
- (g) WI proposing change to ES = 15  $\mu\text{g}/\text{t}$  and PAL = 1.5  $\mu\text{g}/\text{t}$
- $\mu\text{g}/\text{t}$  = micrograms per liter
- SDWA = Safe Drinking Water Act
- MCL = Maximum Contaminant Level
- MCLG = Maximum Contaminant Level Goal
- WI = Wisconsin
- ES = Enforcement Standard
- PAL = Preventive Action Limit
- TT = Treatment technique requirement in effect
- Copper action level = 1,300  $\mu\text{g}/\text{t}$ . Lead action level = 15  $\mu\text{g}/\text{t}$



**TABLE 8-18**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup>**  
**NITROGLYCERINE POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
HG	1:2	2.4
NG	2:2	15.8
NH3	2:2	17.7
PB	2:2	10,000
<u>Surface Water<sup>D</sup></u>		
AL	2:2	3,020
AS	2:2	5.43
BA	2:2	63.1
CL	2:2	1,930
FE	2:2	3,970
HG	2:2	0.325
MN	2:2	207
NH3N2	2:2	147
PB	2:2	45.9
SO4	2:2	4,470
V	2:2	8.37
<u>Sediment<sup>E</sup></u>		
CR	8:8	40.5
HG	8:8	20
NH3	8:8	72.5
PB	8:8	410

**Notes:**

- <sup>A</sup> Constituents selected based on criteria presented in Tables Q-18, Q-19, and Q-20 and discussed in Section 5.0.  
<sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$  (surface soil and sediment) and  $\mu\text{g/l}$  (surface water).  
<sup>C</sup> Assessment of surface soil contamination was performed using samples from NPS-91-09 and NPS-91-10.  
<sup>D</sup> Assessment of surface water contamination was performed using samples NPW-91-01 and NPW-91-02.  
<sup>E</sup> Assessment of sediment contamination was performed using samples NPS-91-01 and NPS-91-08.



**TABLE 8-19**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup>**  
**ROCKET PASTE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil<sup>C</sup></u>		
24DNT	12:72	810
26DNT	10:72	32.5
BAANTR	4:72	0.666
CHRY	8:72	1
CR	66:66	109
DEP	37:72	49.8
FANT	20:72	1.12
HG	17:66	0.716
NG	42:66	1,500
NIT	65:66	120
NNDMEA	7:22	0.302
NNDNPA	5:72	0.23
NNDPA	58:72	10,000
PB	66:66	3,500
PHANTR	14:72	0.279
PYR	8:72	0.932
SO4	17:66	22.9
<u>Surface Water<sup>D</sup></u>		
AL	2:2	31,400
AS	2:2	15
BA	2:2	290
BE	1:2	2.17
CL	2:2	2,730
CR	1:2	59.5
CU	2:2	79.1
FE	2:2	31,700



continued

TABLE 8-19  
ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup>  
ROCKET PASTE AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
MN	2:2	503
NH3N2	2:2	63.4
NI	1:2	40.7
NIT	1:2	10.5
PB	2:2	3,100
SO4	2:2	35,000
V	2:2	57.1
ZN	2:2	151
<u>Sediment<sup>E</sup></u>		
CR	2	45.7
DEP	1	2.46
NG	1	1.76
NIT	2	2.22
NNDPA	2	4.98
PB	2	2,500
SO4	2	210

Notes:

- <sup>A</sup> Constituents selected based on criteria presented in Tables Q-16 and Q-17 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$  (surface soil) and  $\mu\text{g/l}$  (surface water).
- <sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from RPS-91-03 through RPS-91-68.
- <sup>D</sup> Assessment of surface water contamination was performed using samples from RPW-91-01 and RPW-91-02.
- <sup>E</sup> Assessment of sediment contamination was performed using samples from RPS-91-01 and RPS-91-02.



**TABLE 8-20**  
**RISK EVALUATION FOR AQUATIC RECEPTORS**  
**NITROGLYCERINE POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	EXPOSURE POINT CONCENTRATION <sup>A</sup>	RTV <sup>B</sup>	HAZARD QUOTIENT <sup>C</sup>
<u>Surface Water</u>			
AL	3,020	248	4
AS	5.43	153	0.035
BA	63.1	1,360	0.046
FE	31,700	1,000	31.7
CL	1,930	230,000	0.02
HG	0.325	0.012	27
MN	207	100	2.1
NH3N2	147	2,100	0.07
PB	45.9	3.2	14
SO4	4,470	1,060,000	0.0042
V	8.37	200	0.042
<u>Sediments</u>			
CR	40.5	100	0.41
HG	20	0.1	200
NH3	72.5	75	0.97
PB	410	50	8.2

**Notes:**

- <sup>A</sup> Analytical results presented in Tables Q-19 and Q-20 and summarized in Table 8-18.
- <sup>B</sup> Reference Toxicity Value (RTV) derived from available quality criteria and effects threshold levels as presented in Table Q-3.
- <sup>C</sup> Calculated by dividing the exposure point concentration by the RTV; values in excess of 1.0E+00 indicate that the protective RTV was exceeded by environmental concentrations.



**TABLE 8-21**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS**  
**NITROGLYCERINE POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>A</sup>	
	ACUTE Risk <sup>B</sup>	CHRONIC Risk <sup>C</sup>
Short-tailed shrew	1.9E+04	3.8E+05
Eastern meadowlark	4.3E+02	4.8E+02
Garter snake	9.3E+02	7.4E+03
Red fox	1.7E+01	1.3E+00
Red-tailed hawk	5.0E+01	2.3E+00

**Notes:**

<sup>A</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dosage by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-55 and R-56 for acute and chronic exposures, respectively.

<sup>B</sup> Based on comparison with acute RTVs.

<sup>C</sup> Based on comparison with chronic RTVs.



**TABLE 8-22**  
**RISK EVALUATION FOR AQUATIC RECEPTORS**  
**ROCKET PASTE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	EXPOSURE POINT CONCENTRATION <sup>a</sup>	RTV <sup>b</sup>	HAZARD QUOTIENT <sup>c</sup>
<u>Surface Water</u>			
AL	31,400	748	41.9
AS	15	153	0.098
BA	290	1,360	0.21
BE	2.17	5.3	0.41
CL	2,730	230,000	0.029
CR	59.5	9.74	6.1
CU	79.1	2.27	35
FE	31,700	1,000	32
MN	503	100	5
NH3N2	63.4	2,100	0.03
NI	40.7	66.13	0.62
NIT	10.5	5,000	0.0021
PB	3,100	3.2	970
SO4	35,000	1,060,000	0.033
V	57.1	200	0.29
ZN	151	49.59	3
<u>Sediment</u>			
CR	45.7	100	.46
NIT	2.22	54.5	.004
PB	2,600	50	52
SO4	210	-	-
DEP	2.46	-	-



continued

**TABLE 8-22**  
**RISK EVALUATION FOR AQUATIC RECEPTORS**  
**ROCKET PASTE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	EXPOSURE POINT CONCENTRATION <sup>A</sup>	RTV <sup>B</sup>	HAZARD QUOTIENT <sup>C</sup>
NNDPA	4.98	-	-
NG	1.75	-	-

**Notes:**

<sup>A</sup> Analytical results presented in Tables Q-17 and summarized in Table 8-19.

<sup>B</sup> Reference Toxicity Value (RTV) derived from available quality criteria and effects threshold levels as presented in Table Q-3

<sup>C</sup> Calculated by dividing the exposure point concentration by the RTV; values in excess of 1.0E+00 indicate that the protective RTV was exceeded by environmental concentrations.



**TABLE 8-23**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS**  
**ROCKET PASTE AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>A</sup>	
	ACUTE RISK <sup>B</sup>	CHRONIC RISK <sup>C</sup>
Short-tailed shrew	6.6E+03	1.3E+05
Eastern meadowlark	1.5E+02	4.4E+02
Garter snake	3.3E+02	6.5E+03
Red fox	1.9E+01	1.4E+02
Red-tailed hawk	2.9E+01	3.0E+02

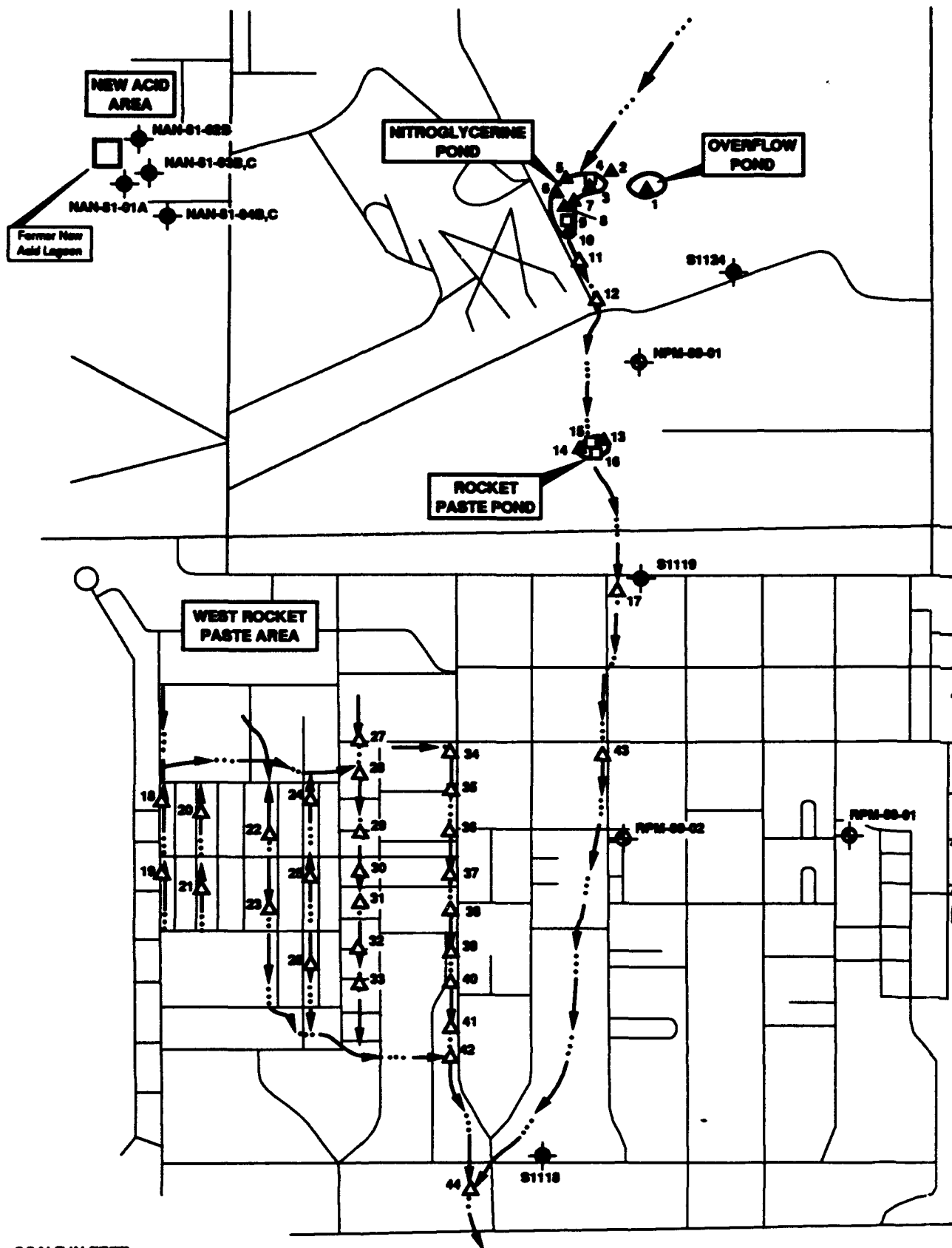
**Notes:**

<sup>A</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dosage by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-53 and R-54 for acute and chronic exposures, respectively.

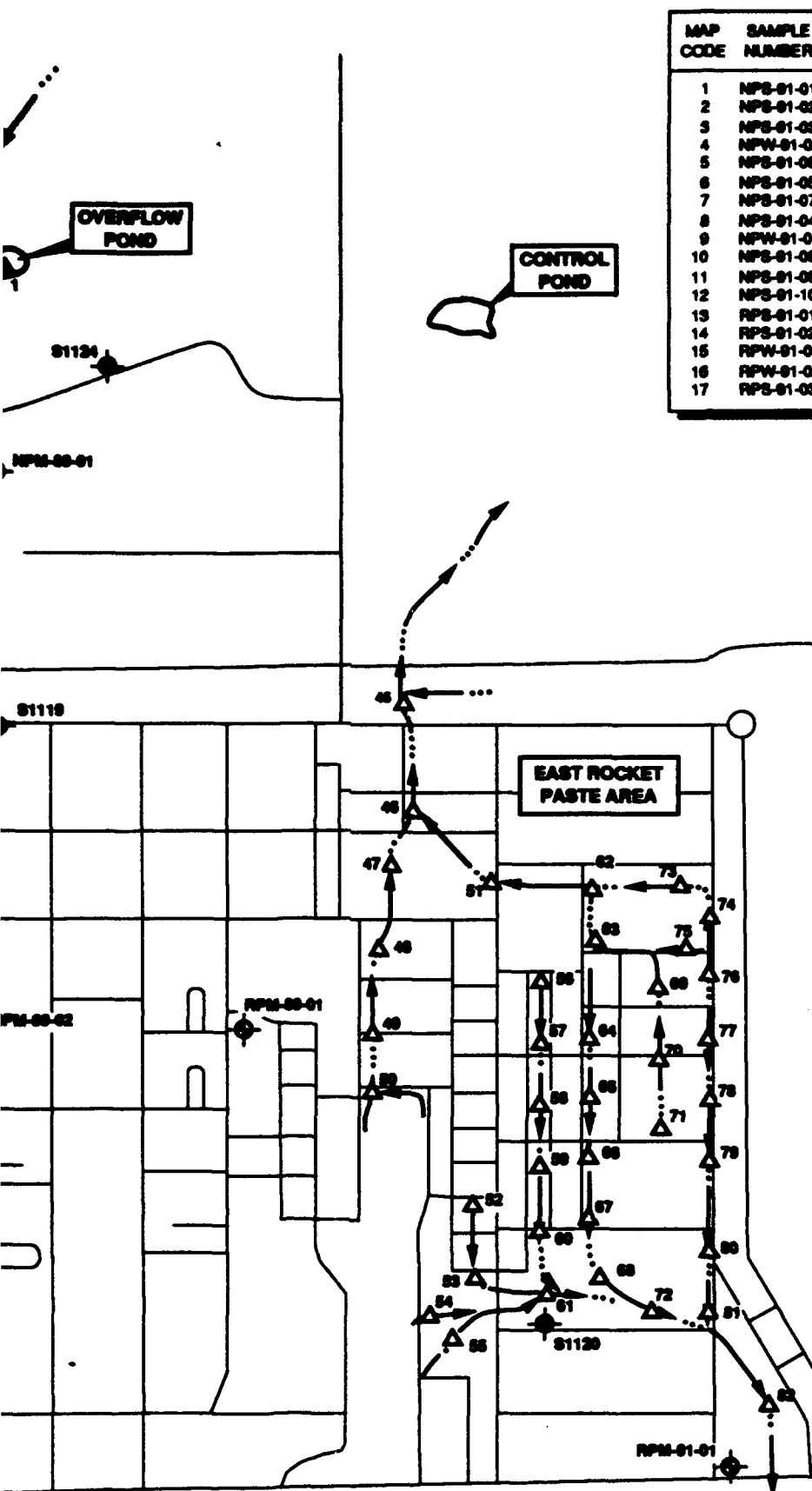
<sup>B</sup> Based on comparison with acute RTVs.

<sup>C</sup> Based on comparison with chronic RTVs.









MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-09	69	RPS-01-01
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3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-02
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	55	RPS-01-08	72	RPS-01-08
5	NPS-01-08	22	RPS-01-30	39	RPS-01-20	56	RPS-01-05	73	RPS-01-05
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-06	74	RPS-01-06
7	NPS-01-07	24	RPS-01-38	41	RPS-01-32	58	RPS-01-07	75	RPS-01-07
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-14
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-08	77	RPS-01-08
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-09	78	RPS-01-09
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-08	79	RPS-01-08
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-09	80	RPS-01-09
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-09	81	RPS-01-09
14	RPS-01-02	31	RPS-01-09	48	RPS-01-08	65	RPS-01-13	82	RPS-01-13
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-01	83	RPS-01-01
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-02	84	RPS-01-02
17	RPS-01-03	34	RPS-01-05	51	RPS-01-04	68	RPS-01-08	85	RPS-01-08

### LEGEND

- PAVED ROAD OR TRAMWAY
- ... DRAINAGE DITCH
- S1119 — EXISTING MONITORING WELL
- RPM-00-02 — NEW MONITORING WELL
- ▲ SEDIMENT SAMPLE
- △ SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### NOTES:

1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION
2. S1100 SERIES AND 81 SERIES WELL LOCATIONS BASED ON MEP (TSAI, 1988)
3. 1989 AND 91 SERIES WELL LOCATIONS BASED ON VIERBICHER SURVEY DATA (APPENDIX B)
4. SURFACE SOIL AND SURFACE WATER SAMPLE LOCATIONS BASED ON FIELD SURVEY DATA BY ABB-ES.

FIG. 1  
SITE LOCATION MAP  
SEDIMENT, SURFACE SOIL  
SURFACE WATER SAMPLE LOCATIONS  
NITROGLYCERIN  
ROCKET PASTE AREA AND NEW AMMUNITION  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental Services



MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
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3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-62	71	RPS-01-46
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	55	RPS-01-63	72	RPS-01-47
5	NPS-01-08	22	RPS-01-30	39	RPS-01-20	56	RPS-01-65	73	RPS-01-36
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-66	74	RPS-01-57
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-57	75	RPS-01-44
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-38
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-58	77	RPS-01-39
10	NPS-01-06	27	RPS-01-08	44	RPS-01-16	61	RPS-01-59	78	RPS-01-40
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-48	79	RPS-01-41
12	NPS-01-10	29	RPS-01-24	46	RPS-01-64	63	RPS-01-49	80	RPS-01-42
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81	RPS-01-43
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-13	82	RPS-01-15
15	RPW-01-01	32	RPS-01-26	49	RPS-01-67	66	RPS-01-51		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-68	67	RPS-01-52		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-64	68	RPS-01-53		

### LEGEND

— PAVED ROAD OR TRAMWAY

...—> DRAINAGE DITCH

S1119  EXISTING MONITORING WELLS

RPM-01-02  NEW MONITORING WELLS

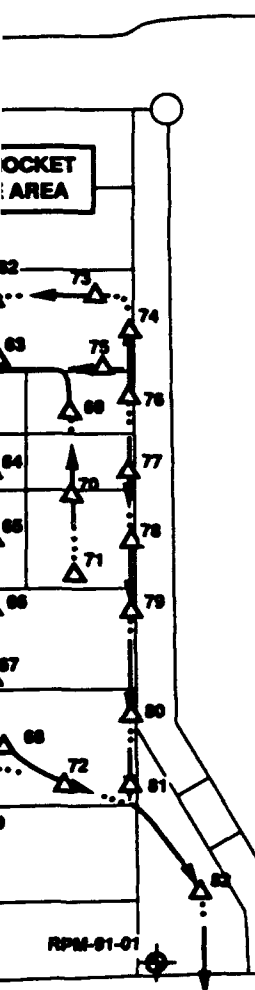
 SEDIMENT SAMPLE

 SURFACE SOIL SAMPLE

 SURFACE WATER SAMPLE

### NOTES:

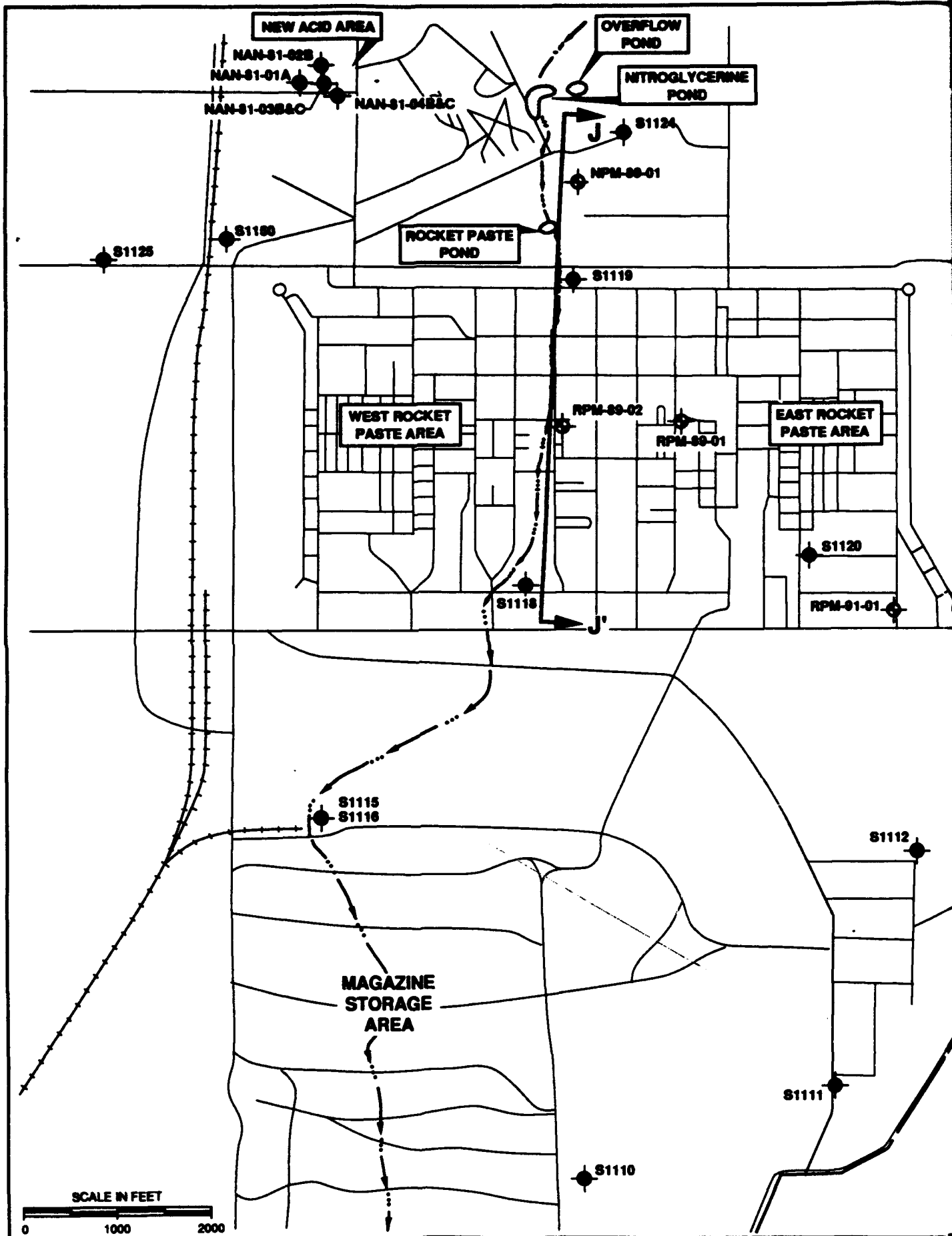
1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. S1100 SERIES AND 81 SERIES WELL LOCATIONS BASED ON MEP (TSAI, 1988)
3. 1989 AND 91 SERIES WELL LOCATIONS BASED ON VIERBICHER SURVEY DATA (APPENDIX F).
4. SURFACE SOIL AND SURFACE WATER SAMPLE LOCATIONS BASED ON FIELD SURVEY CONDUCTED BY ABB-ES.



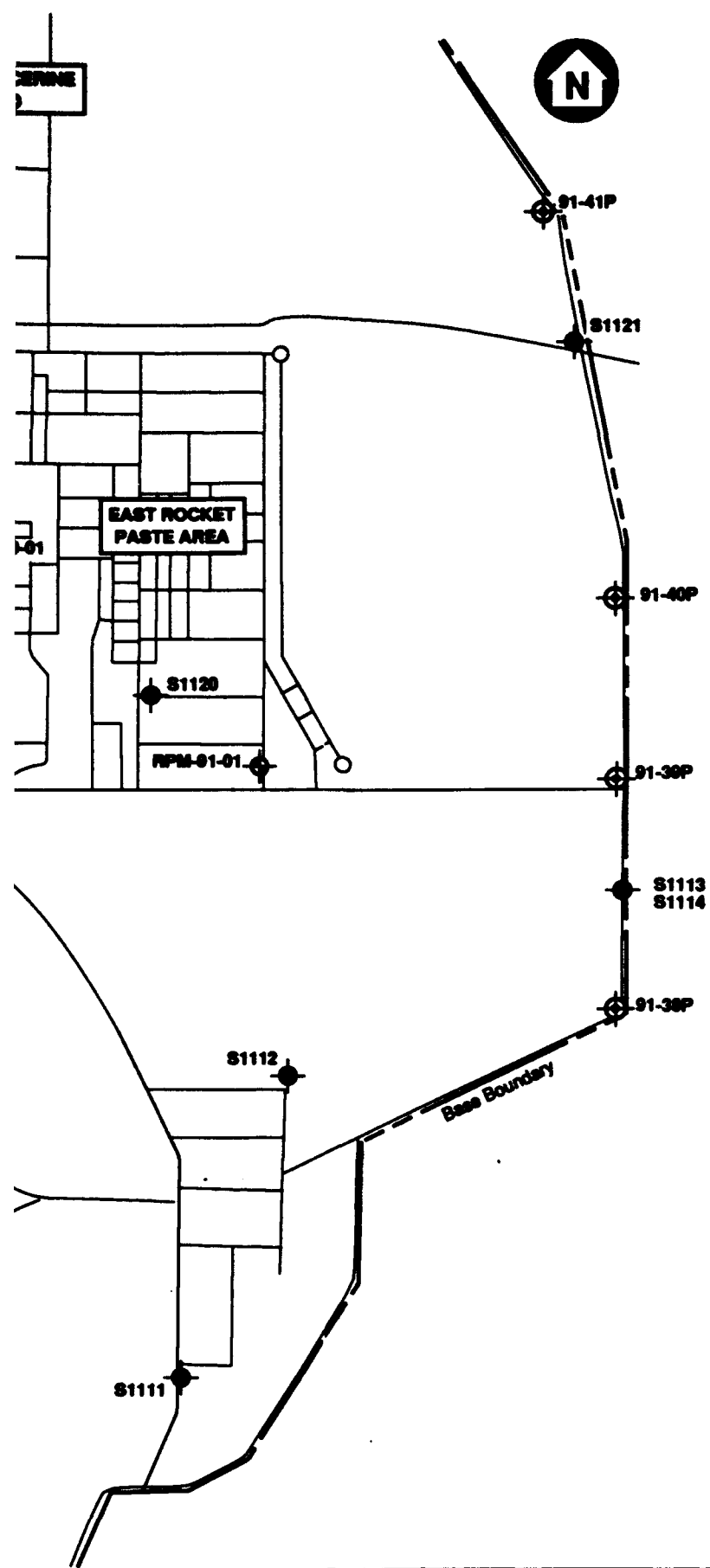
**FIGURE 8-1**  
**SITE LOCATION PLAN AND**  
**SEDIMENT, SURFACE SOIL AND**  
**SURFACE WATER SAMPLE LOCATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.









### LEGEND

- PAVED ROAD OR TRAMWAY
- ... — DRAINAGE DITCH
- S1119 ● EXISTING MONITORING WELL LOCATION AND DESIGNATION
- RPM-00-02 ● NEW MONITORING WELL LOCATION AND DESIGNATION
- 91-40P ● NEW FUDS PIEZOMETER LOCATION AND DESIGNATION
- J J ORIENTATION OF GEOLOGIC CROSS SECTION

### NOTES:

1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. S1100 SERIES AND 81 SERIES WELL LOCATIONS BASED ON MEP (TSAI, 1988).
3. 1989 AND 91 SERIES WELL LOCATIONS BASED ON VIERBICHER SURVEY DATA (APPENDIX F).
4. NEW MONITORING WELLS INSTALLED UNDER THE DIRECTION OF ABB-ES.
5. EXISTING MONITORING WELLS INSTALLED UNDER THE DIRECTION OF OLIN CORPORATION.
6. FUDS PIEZOMETERS INSTALLED UNDER THE DIRECTION OF COE - ST. PAUL DISTRICT.

**FIGURE 2**  
**MONITORING WELL LOCATIONS**  
**ORIENTATION OF GEOLOGIC CROSS SECTION**  
**NITROGLYCERINE PASTE AREA**  
**AND NEW ACID REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

— ABB Environmental Services





### LEGEND

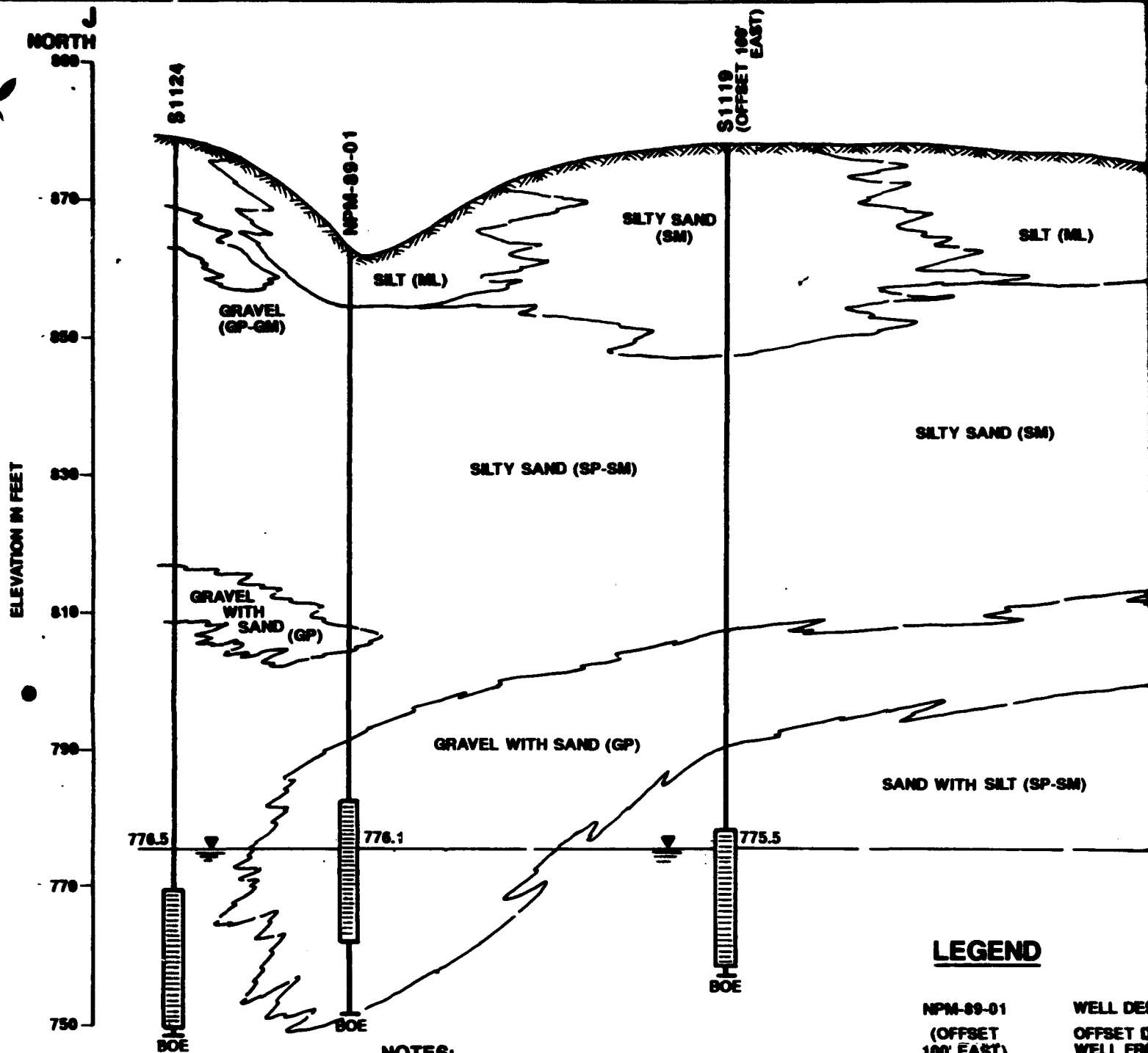
- PAVED ROAD OR TRAMWAY
- ... — DRAINAGE DITCH
- S1119 — EXISTING MONITORING WELL LOCATION AND DESIGNATION
- RPM-88-02 — NEW MONITORING WELL LOCATION AND DESIGNATION
- 91-40P — NEW FUDS PIEZOMETER LOCATION AND DESIGNATION
- J — J' ORIENTATION OF GEOLOGIC CROSS SECTION

### NOTES:

1. BASE MAP FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. S1100 SERIES AND 81 SERIES WELL LOCATIONS BASED ON MEP (TSAI, 1988).
3. 1989 AND 91 SERIES WELL LOCATIONS BASED ON VIERBICHER SURVEY DATA (APPENDIX F).
4. NEW MONITORING WELLS INSTALLED UNDER THE DIRECTION OF ABB-ES.
5. EXISTING MONITORING WELLS INSTALLED UNDER THE DIRECTION OF OLIN CORPORATION.
6. FUDS PIEZOMETERS INSTALLED UNDER THE DIRECTION OF COE - ST. PAUL DISTRICT.

**FIGURE 8-2**  
**MONITORING WELL LOCATIONS AND**  
**ORIENTATION OF GEOLOGIC CROSS SECTION J-J'**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**





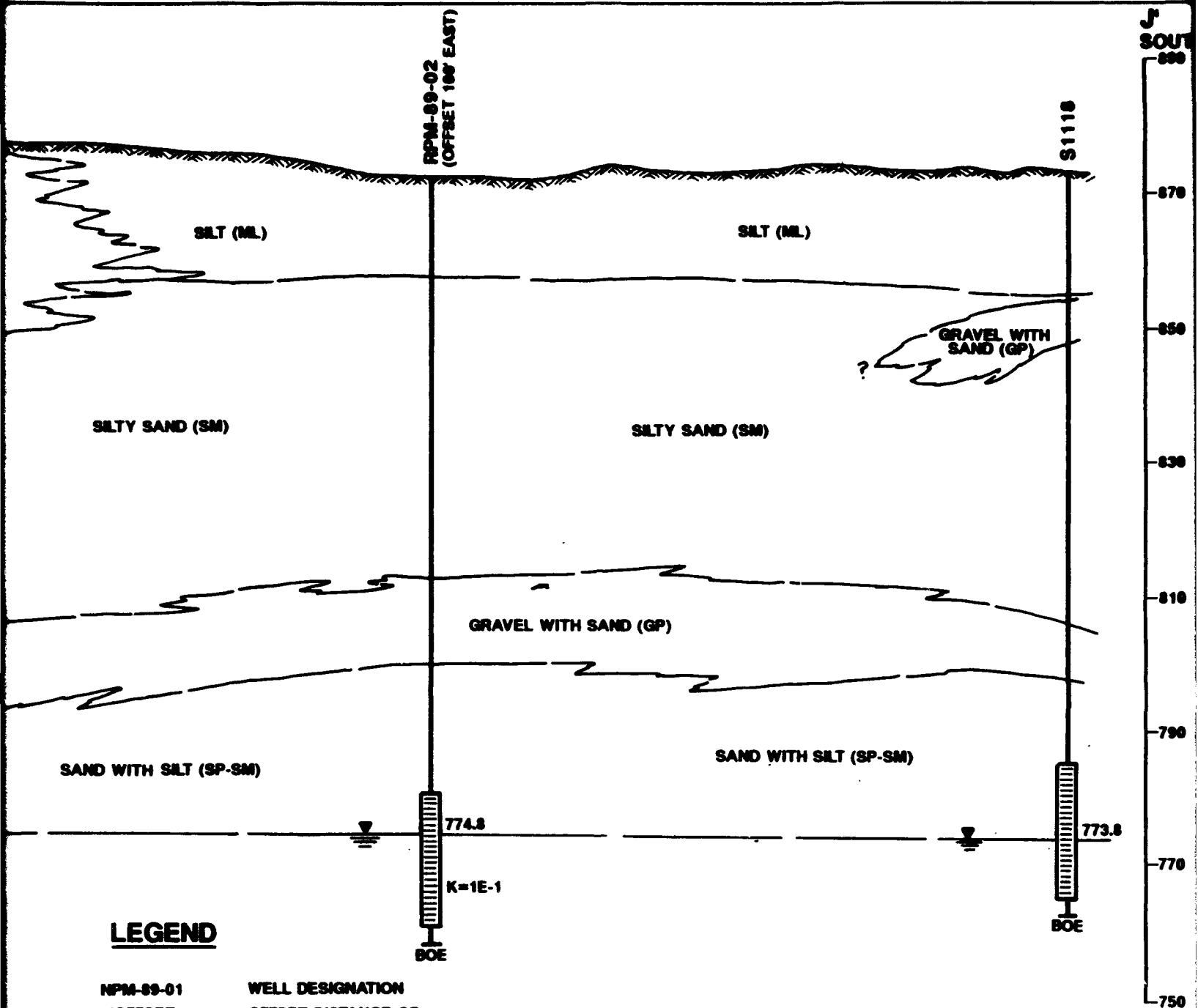
**NOTES:**

1. SEE FIGURE 8-2 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91



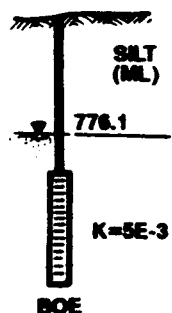


2



## LEGEND

NPM-89-01  
(OFFSET  
100' EAST)



WELL DESIGNATION

OFFSET DISTANCE OF  
WELL FROM TRANSECT

GROUND SURFACE

SOILS DESCRIPTION AND  
USCS CLASSIFICATION

WATER TABLE ELEVATION

SCREENED INTERVAL

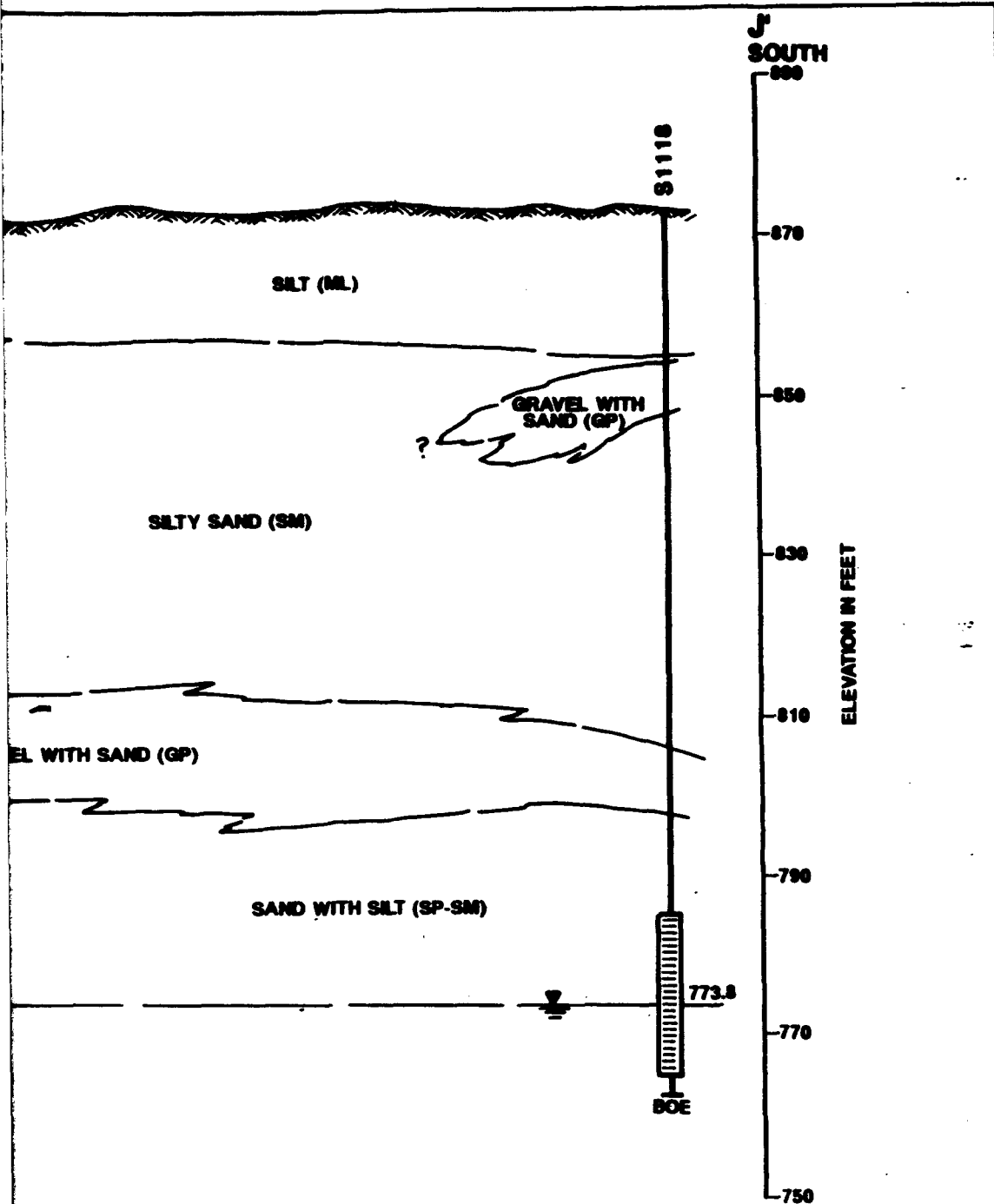
IN-FIELD PERMEABILITY  
TEST RESULTS IN CM/SEC

BOTTOM OF EXPLORATION

**FIGURE 2**  
**GEOLOGIC CROSS SECTION**  
**NITROGLYCERINE**  
**ROCKET PASTE AREA AND NEW ACID**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**

ABS Environmental Services

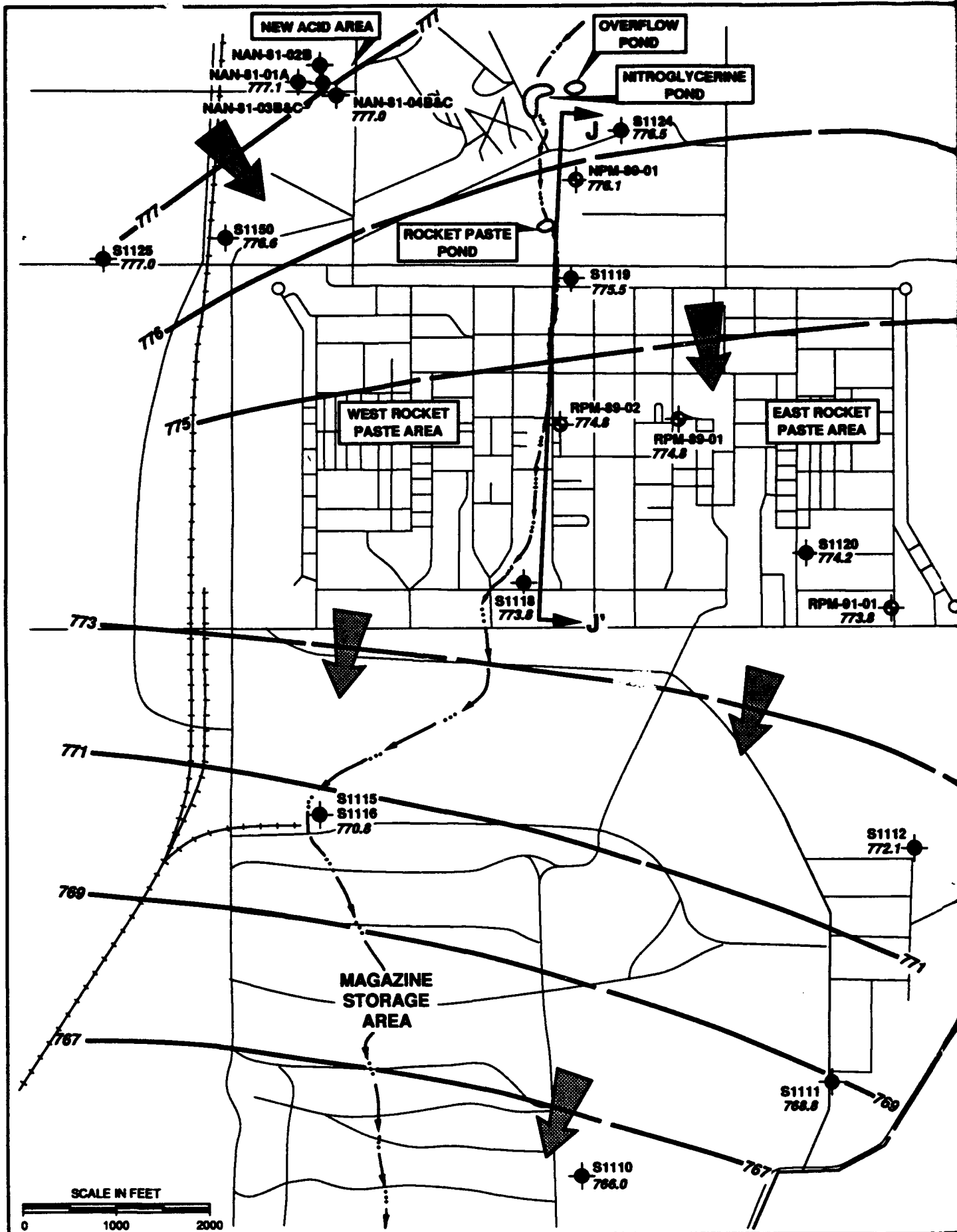




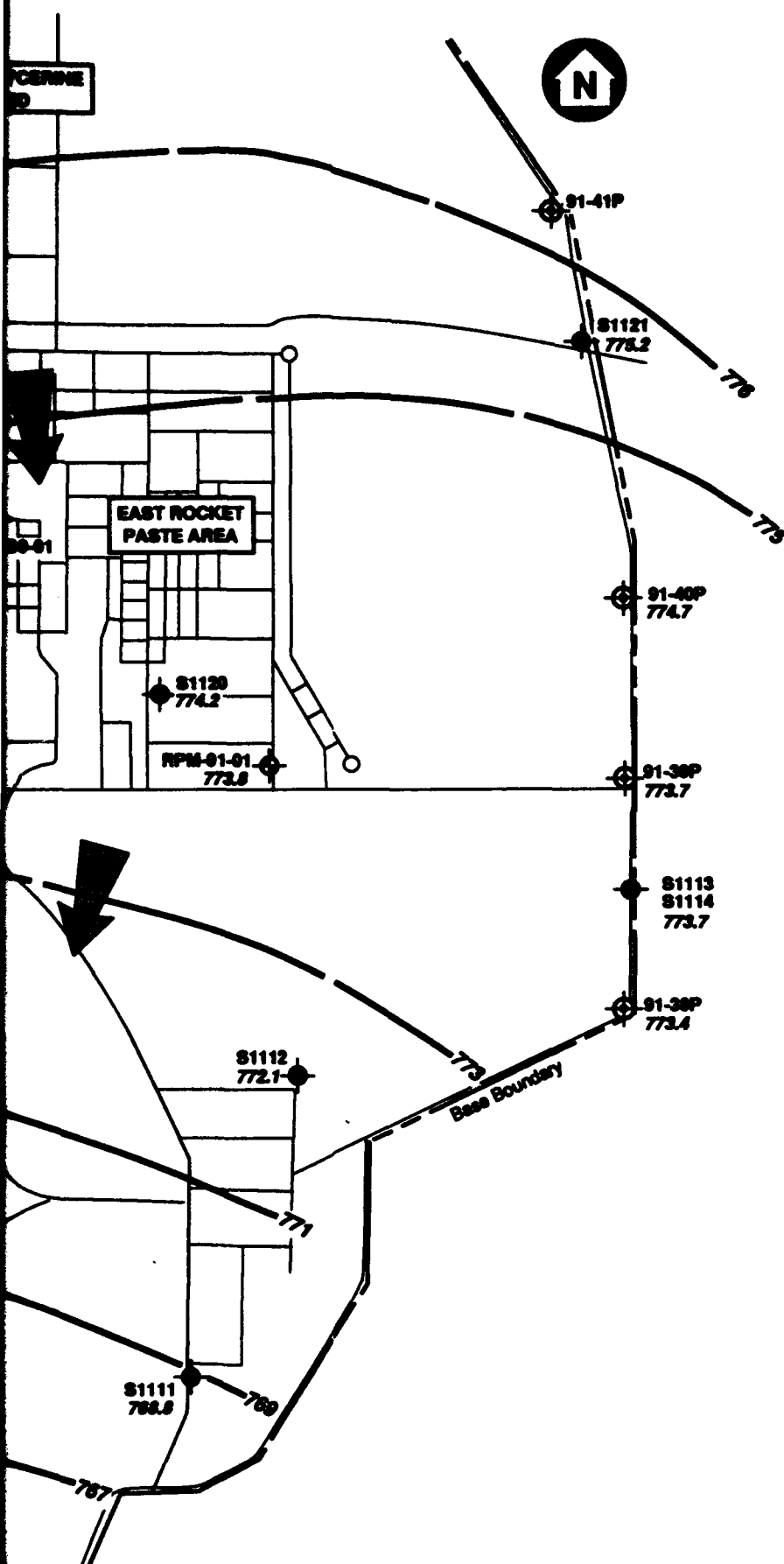
**FIGURE 8-3  
GEOLOGIC CROSS SECTION J-J'  
NITROGLYCERINE POND,  
ROCKET PASTE AREA AND NEW ACID AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLAN**

**ADB Environmental Services, Inc.**





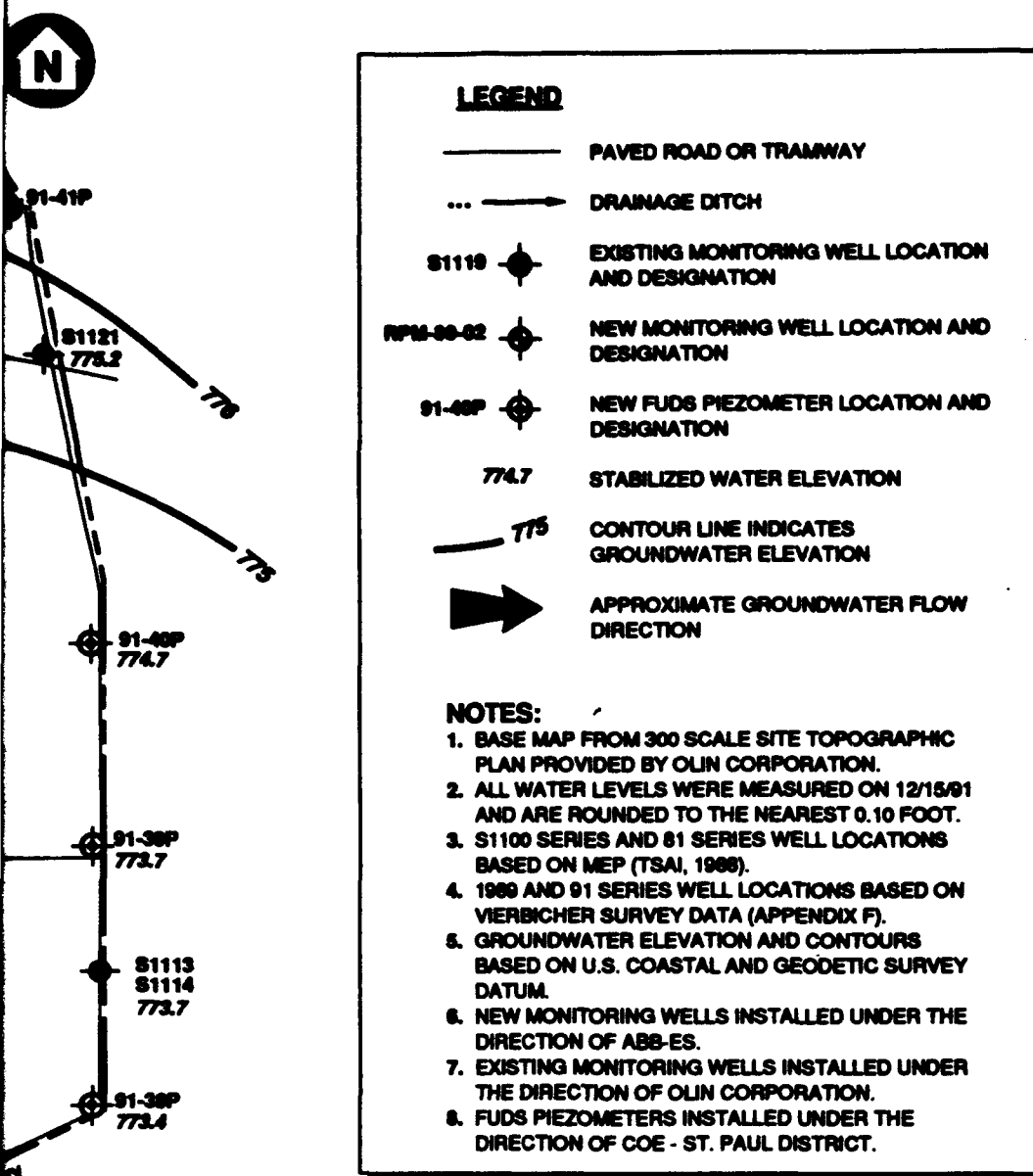




**FIGURE**  
**WATER TABLE CONTOUR P**  
**NITROGLYCERINE PO**  
**ROCKET PASTE AREA AND NEW ACID A**  
**REMEDIAL INVESTIGAT**  
**BADGER ARMY AMMUNITION PL**

— ABB Environmental Services

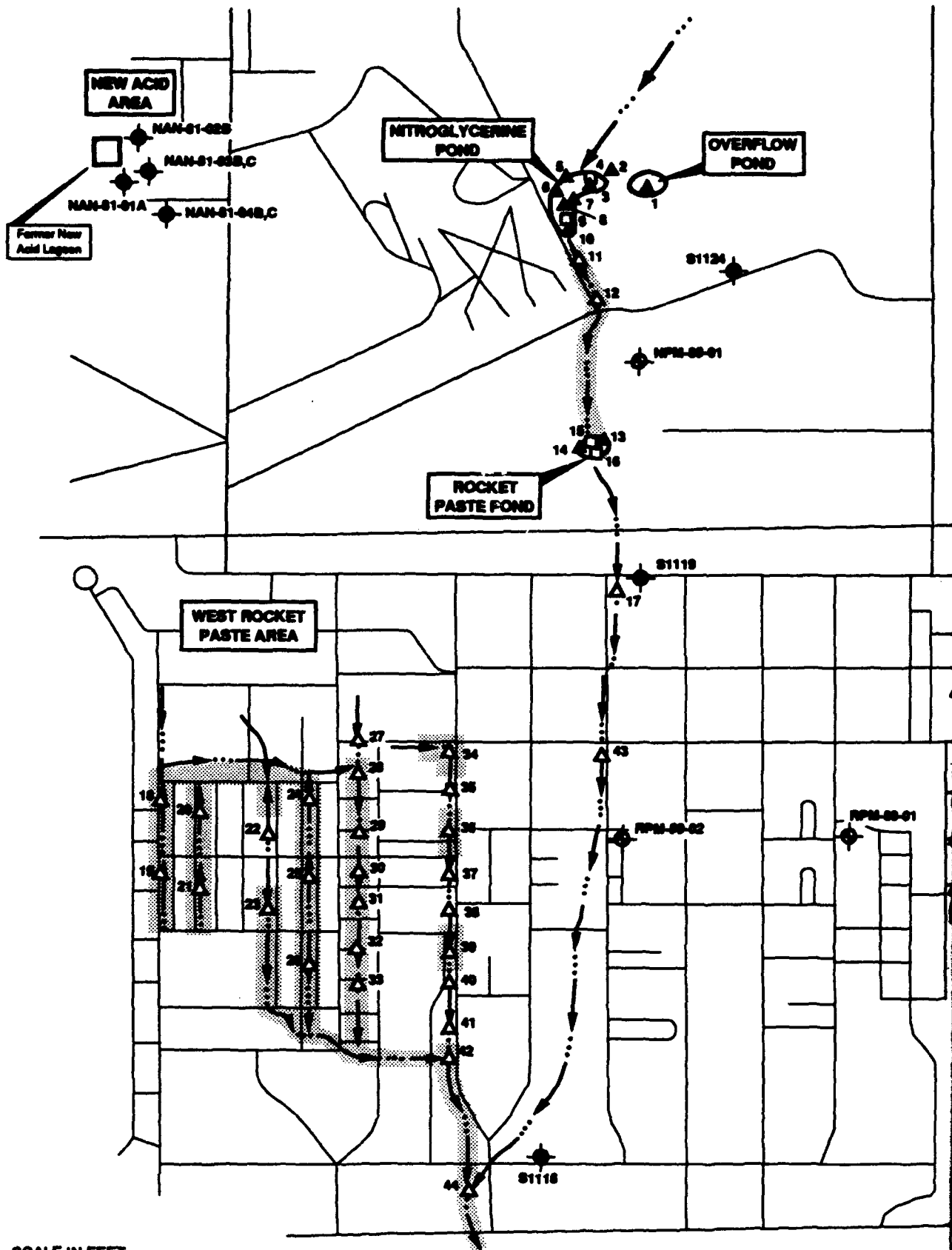




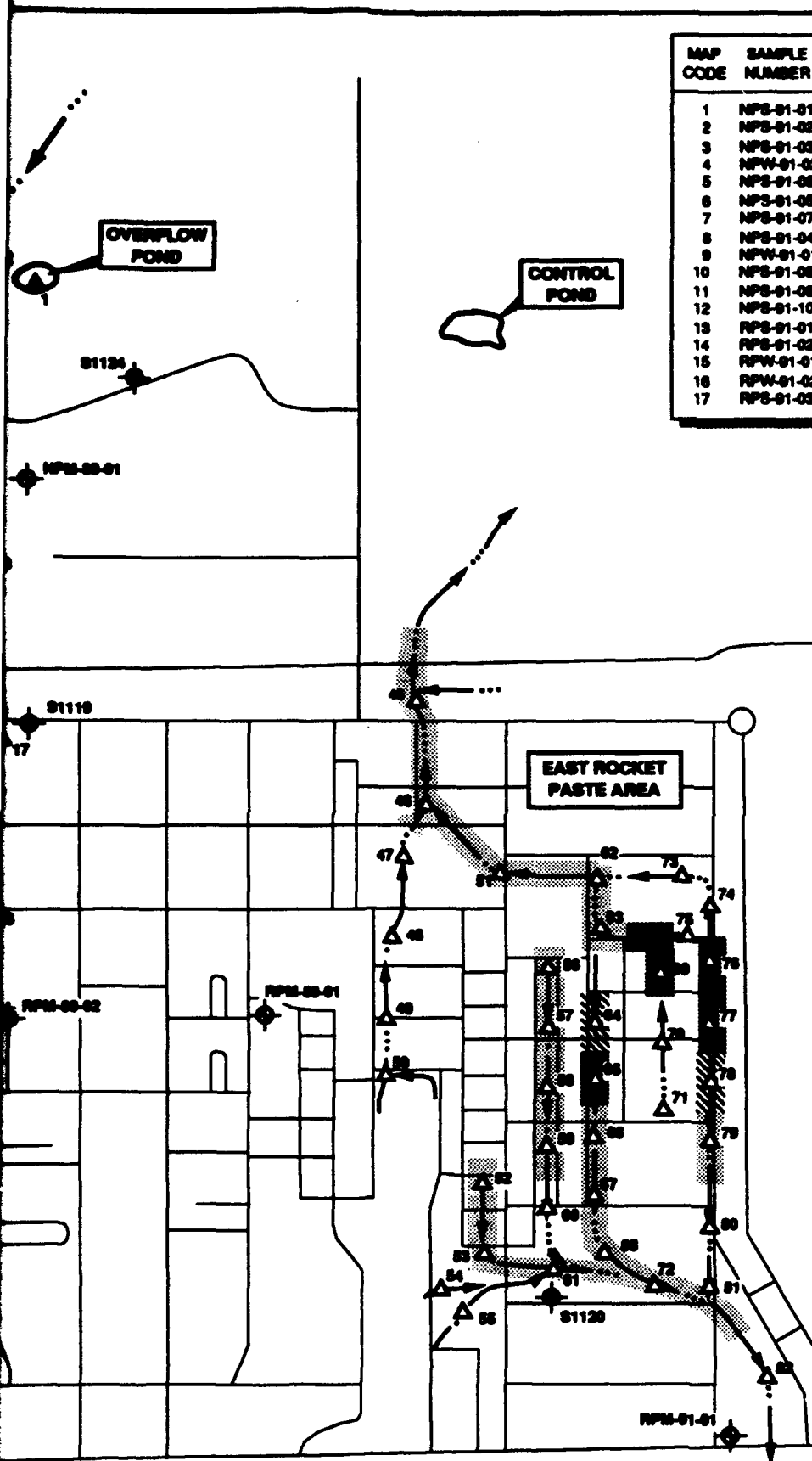
**FIGURE 8-4**  
**WATER TABLE CONTOUR PLAN**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

**-ABB Environmental Services, Inc.-**









MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
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2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-01
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-02
4	NPW-01-02	21	RPS-01-33	38	RPS-01-06	55	RPS-01-03	72	RPS-01-03
5	NPS-01-06	22	RPS-01-30	39	RPS-01-30	56	RPS-01-05	73	RPS-01-05
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-06	74	RPS-01-06
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-07	75	RPS-01-07
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-14
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-08	77	RPS-01-08
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13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-09	81	RPS-01-09
14	RPS-01-02	31	RPS-01-08	48	RPS-01-08	65	RPS-01-13	82	RPS-01-13
15	RPW-01-01	32	RPS-01-28	49	RPS-01-07	66	RPS-01-01	83	RPS-01-01
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17	RPS-01-03	34	RPS-01-05	51	RPS-01-04	68	RPS-01-08	85	RPS-01-08

### LEGEND

- PAVED ROAD OR TRAMM
- ...— DRAINAGE DITCH
- S1119 ● EXISTING MONITORING WELL
- RPM-00-02 ● NEW MONITORING WELL
- ▲ SEDIMENT SAMPLE
- △ SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### NG CONCENTRATIONS

- ▨ >1000 µg/g
- 100 to 999 µg/g
- ▤ >CRL to 99 µg/g

### NOTES:

- SEE TABLE 8-9 OR APPENDIX K FOR CRL DATA SUMMARY.
- CRL = CERTIFIED REPORTING LIMIT

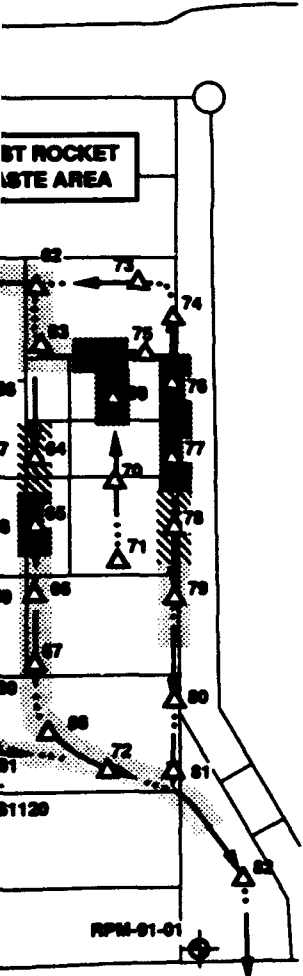
FM  
NG CONCENT  
NITROGLYCERIN  
ROCKET PASTE AREA AND NEW AC  
REMEDIAL INVEST  
BADGER ARMY AMMUNITION  
ABB Environmental S



CONTROL  
NO

MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
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3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-06
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	55	RPS-01-03	72	RPS-01-07
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6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-05	74	RPS-01-09
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-06	75	RPS-01-10
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-11
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-07	77	RPS-01-12
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-08	78	RPS-01-13
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-09	79	RPS-01-14
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-10	80	RPS-01-15
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-11		
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-12		
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-13		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-14		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-14	68	RPS-01-15		

ST ROCKET  
SITE AREA



### LEGEND

- PAVED ROAD OR TRAMWAY
- ... —> DRAINAGE DITCH
- S1119 ● EXISTING MONITORING WELLS
- RPM-01-01 ● NEW MONITORING WELLS
- ▲ SEDIMENT SAMPLE
- △ SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### NG CONCENTRATIONS

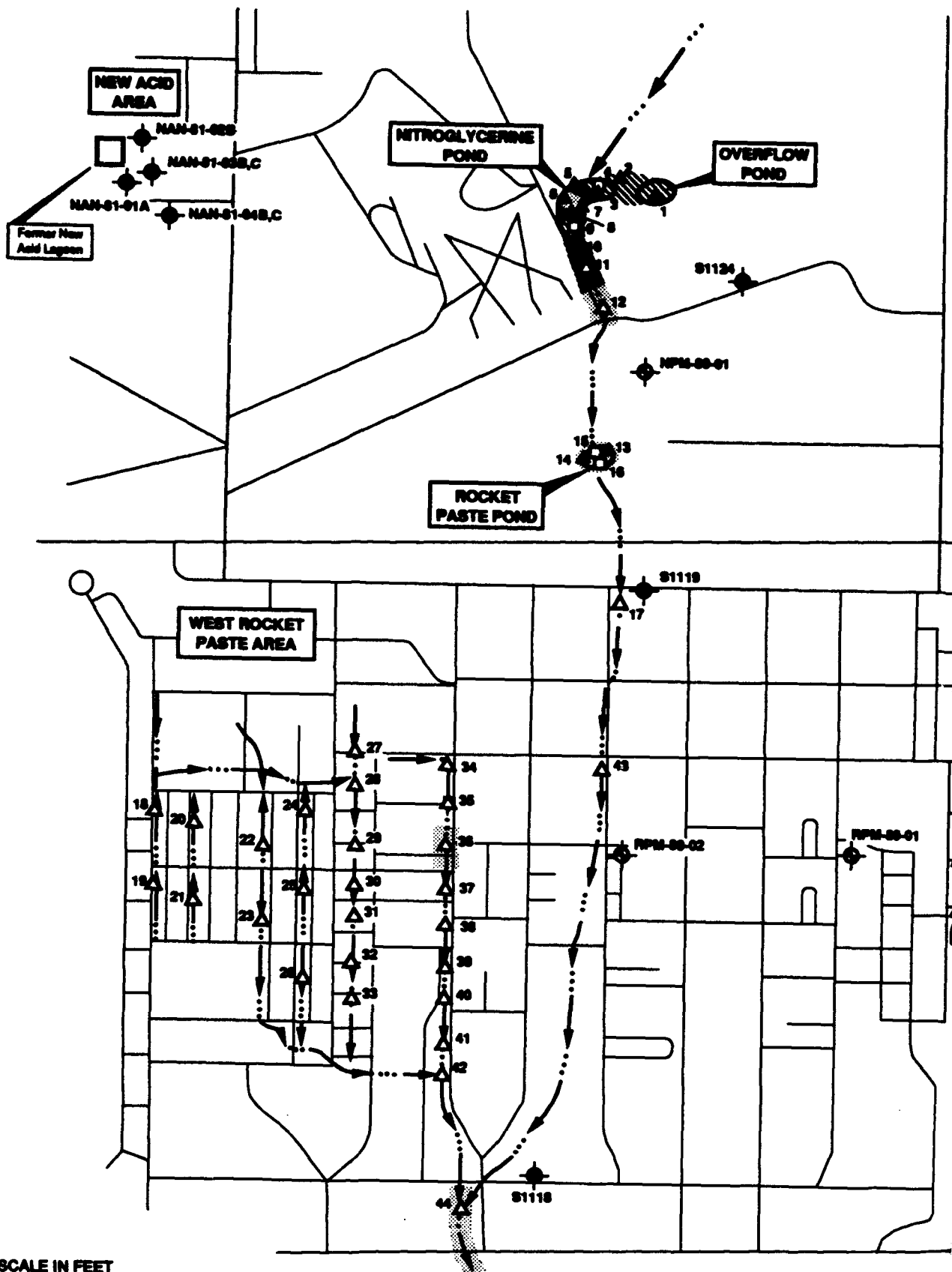
- ▨ >1000 µg/g
- 100 to 999 µg/g
- ░ >CRL to 99 µg/g

### NOTES:

1. SEE TABLE 8-9 OR APPENDIX K FOR CHEMICAL DATA SUMMARY.
2. CRL = CERTIFIED REPORTING LIMIT

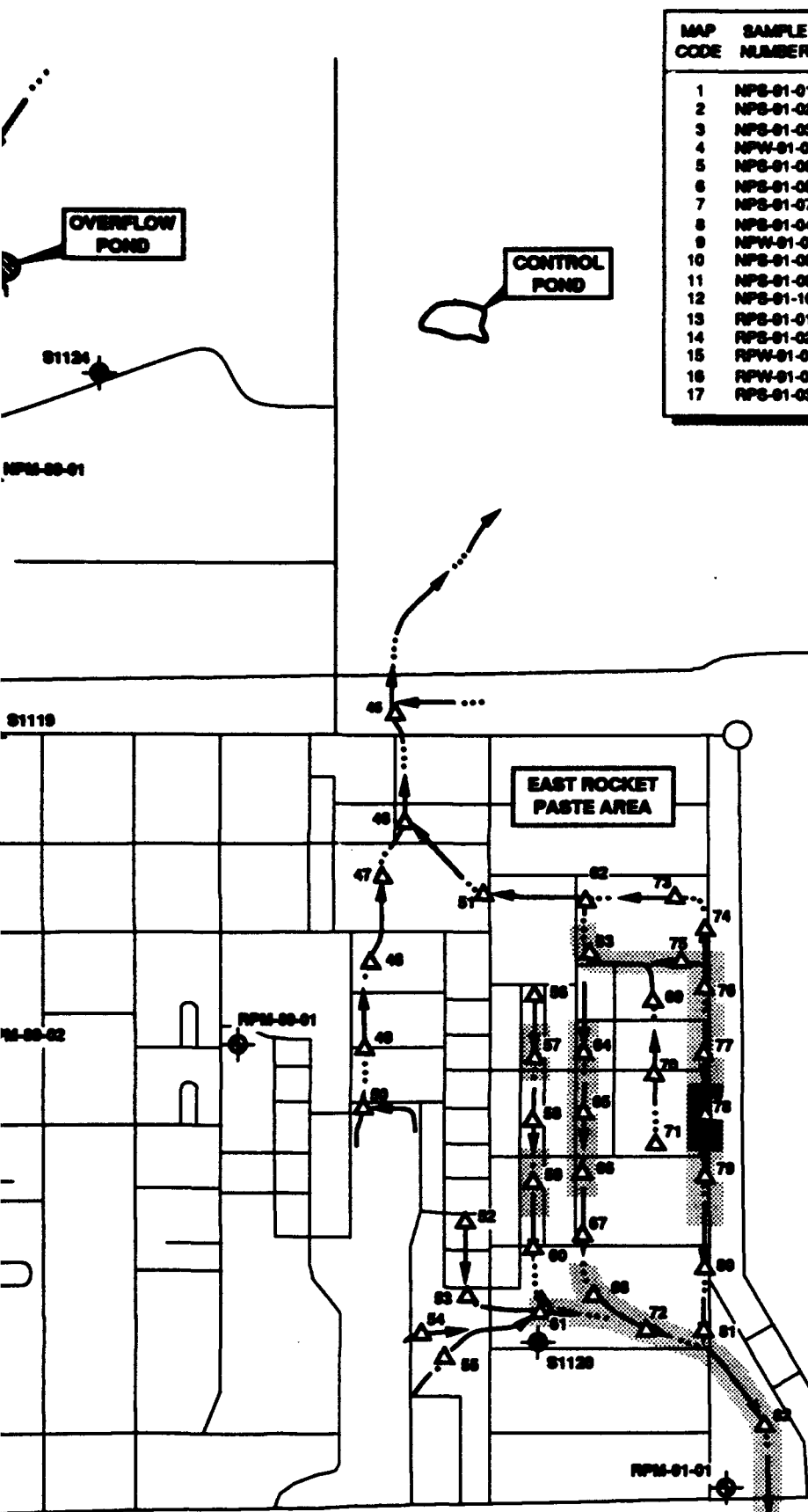
**FIGURE 8-5**  
**NG CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.





SCALE IN FEET  
0 800 1600





MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-08	69	RPS-01-01
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-09	70	RPS-01-02
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-10	71	RPS-01-03
4	NPW-01-02	21	RPS-01-33	38	RPS-01-20	55	RPS-01-11	72	RPS-01-04
5	NPS-01-06	22	RPS-01-30	39	RPS-01-21	56	RPS-01-12	73	RPS-01-05
6	NPS-01-05	23	RPS-01-31	40	RPS-01-22	57	RPS-01-13	74	RPS-01-06
7	NPS-01-07	24	RPS-01-28	41	RPS-01-23	58	RPS-01-14	75	RPS-01-07
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-15	76	RPS-01-08
9	NPW-01-01	26	RPS-01-29	43	RPS-01-08	60	RPS-01-16	77	RPS-01-09
10	NPS-01-08	27	RPS-01-06	44	RPS-01-09	61	RPS-01-17	78	RPS-01-10
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-18	79	RPS-01-11
12	NPS-01-10	29	RPS-01-24	46	RPS-01-12	63	RPS-01-19	80	RPS-01-12
13	RPS-01-01	30	RPS-01-25	47	RPS-01-13	64	RPS-01-20	81	RPS-01-13
14	RPS-01-02	31	RPS-01-08	48	RPS-01-14	65	RPS-01-21	82	RPS-01-14
15	RPW-01-01	32	RPS-01-26	49	RPS-01-15	66	RPS-01-22	83	RPS-01-15
16	RPW-01-02	33	RPS-01-27	50	RPS-01-16	67	RPS-01-23	84	RPS-01-16
17	RPS-01-03	34	RPS-01-05	51	RPS-01-17	68	RPS-01-24	85	RPS-01-17

### LEGEND

— PAVED ROAD OR TRAMWAY

... — DRAINAGE DITCH

S1119 — EXISTING MONITORING WELL

NPM-01-02 — NEW MONITORING WELL

▲ SEDIMENT SAMPLE

△ SURFACE SOIL SAMPLE

□ SURFACE WATER SAMPLE

### HG CONCENTRATIONS

▨ >10 µg/g

■ 0.5 to 9.9 µg/g

▤ >CRL to 0.5 µg/g

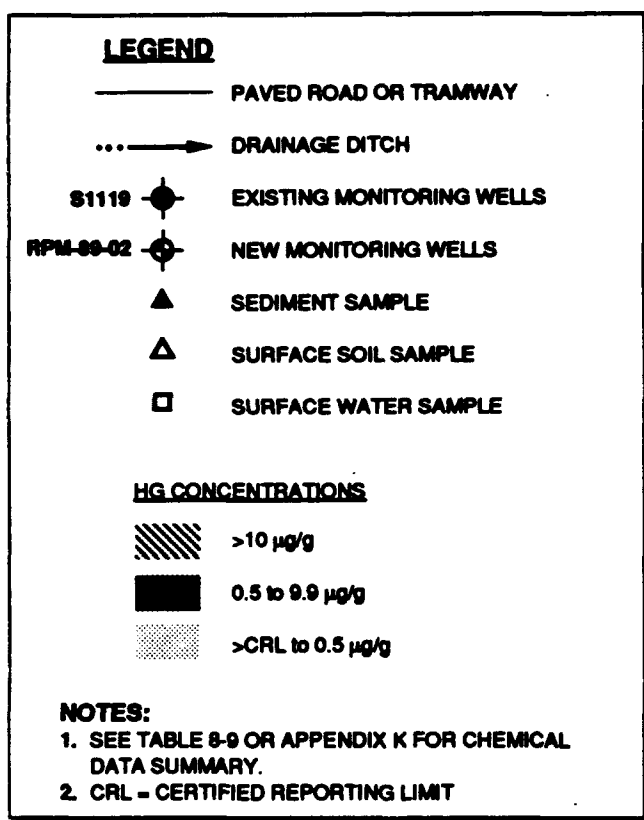
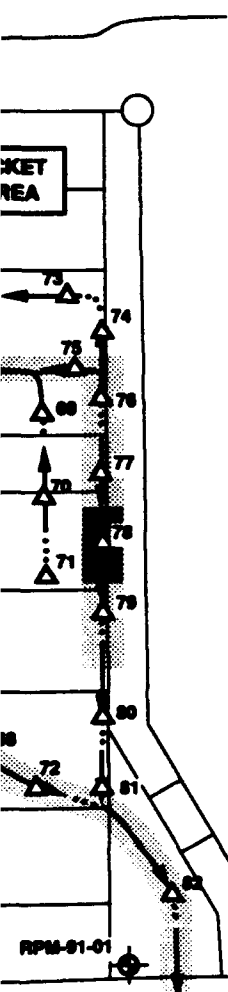
### NOTES:

1. SEE TABLE 8-9 OR APPENDIX K FOR CHEMICAL DATA SUMMARY.
2. CRL = CERTIFIED REPORTING LIMIT

FIG  
HG CONCENTRATIONS  
NITROGLYCERINE  
ROCKET PASTE AREA AND NEW AMMUNITION  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT  
ABB Environmental Services

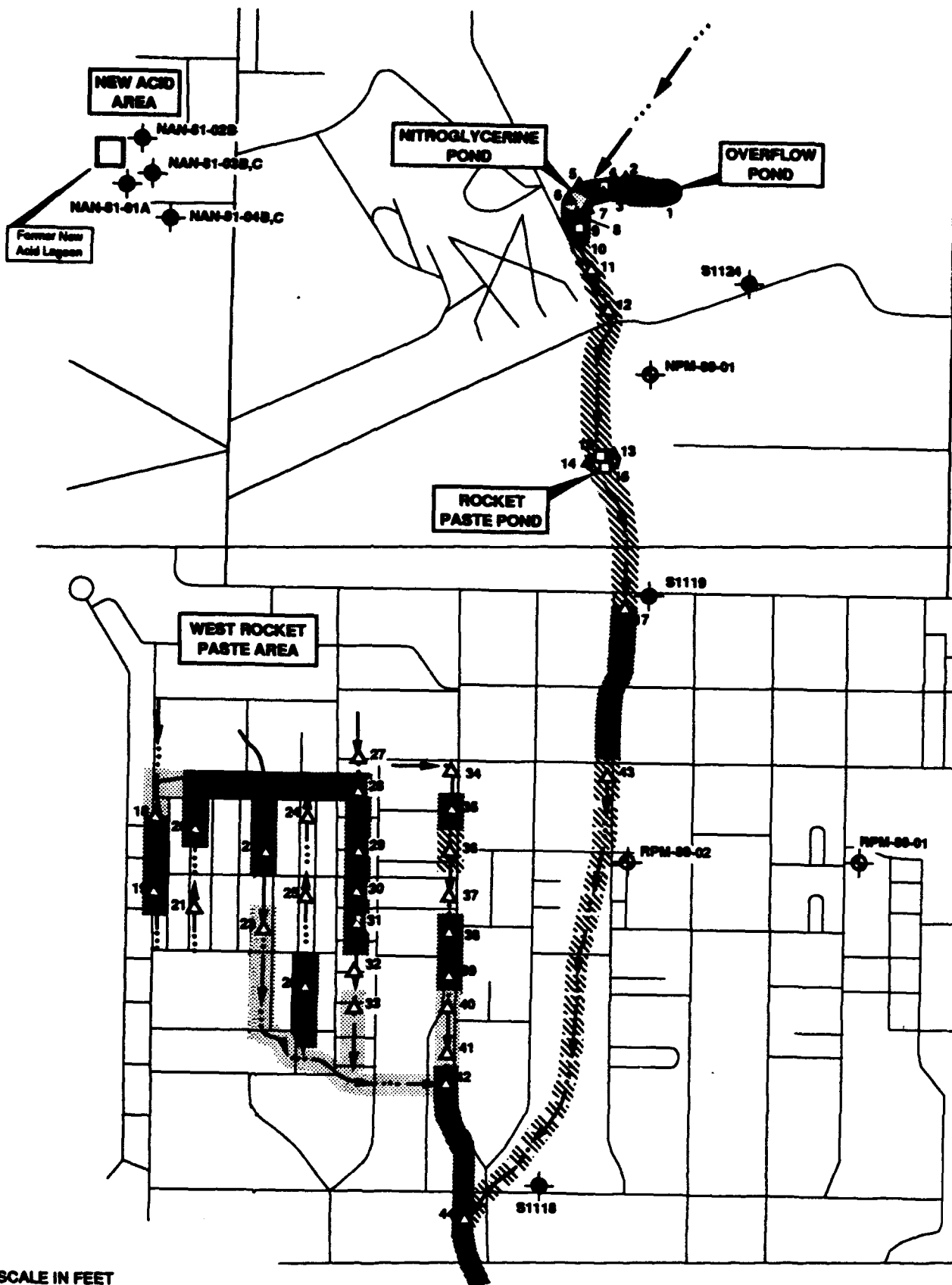


MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-00	69	RPS-01-12
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-45
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-46
4	NPW-01-02	21	RPS-01-33	38	RPS-01-06	55	RPS-01-03	72	RPS-01-47
5	NPS-01-06	22	RPS-01-30	39	RPS-01-20	56	RPS-01-55	73	RPS-01-36
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-56	74	RPS-01-37
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-57	75	RPS-01-44
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-38
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-58	77	RPS-01-39
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-59	78	RPS-01-40
11	NPS-01-06	28	RPS-01-23	45	RPS-01-11	62	RPS-01-48	79	RPS-01-41
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-49	80	RPS-01-42
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81	RPS-01-43
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-13	82	RPS-01-15
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-51		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53		



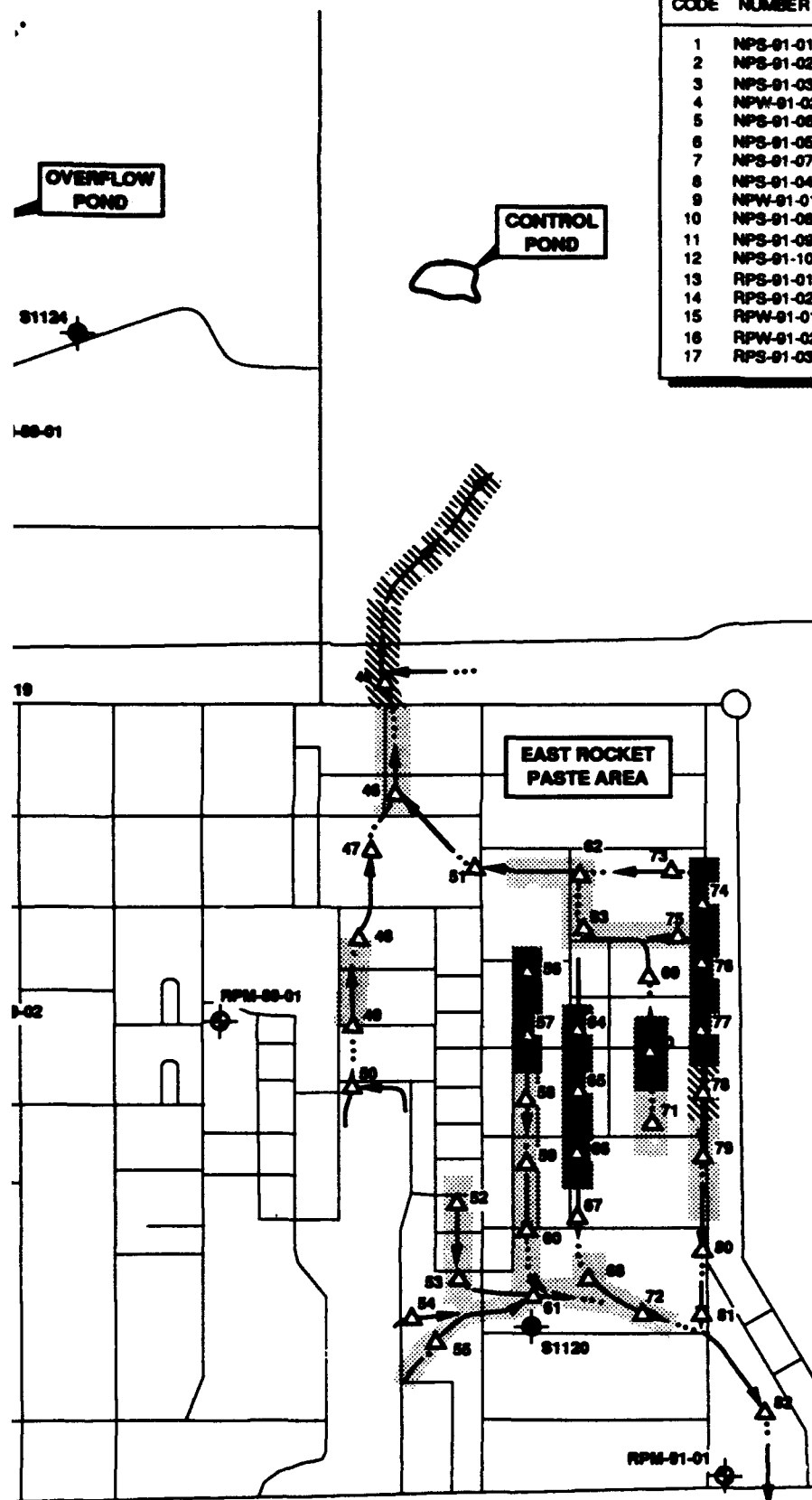
**FIGURE 8-6**  
**HG CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.







MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-09	69
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	55	RPS-01-03	72
5	NPS-01-06	22	RPS-01-30	39	RPS-01-20	56	RPS-01-05	73
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-06	74
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-07	75
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-08	77
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-09	78
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-08	79
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-08	80
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-13	82
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-51	
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52	
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53	



### LEGEND

- PAVED ROAD OR TRAMWAY
- ...— DRAINAGE DITCH
- S1119 ● EXISTING MONITORING WELL
- RPM-01-02 ● NEW MONITORING WELLS
- ▲ SEDIMENT SAMPLE
- △ SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### PB CONCENTRATIONS

- ▨ >1000 µg/g
- 100 to 999 µg/g
- ▤ 30 to 99.9 µg/g
- ▧ ESTIMATED CONCENTRATION

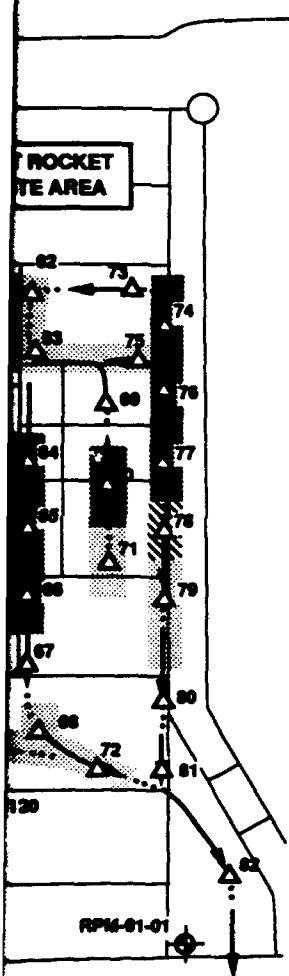
### NOTES:

- SEE TABLE 8-9 OR APPENDIX K FOR CHEM DATA SUMMARY.
- CONCENTRATIONS <30 µg/g ARE CONSIDERED BACKGROUND. SEE SECTION 2.0.
- CONCENTRATIONS ARE INDICATED AS ESTIMATED WHERE DATA POINTS ARE LIMITED.

FIGURE 2  
PB CONCENTRATIONS  
NITROGLYCERINE  
ROCKET PASTE AREA AND NEW ACID  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental Services



MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-00	69	RPS-01-12
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-45
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-46
4	NPW-01-02	21	RPS-01-33	38	RPS-01-06	55	RPS-01-03	72	RPS-01-47
5	NPS-01-06	22	RPS-01-30	39	RPS-01-20	56	RPS-01-05	73	RPS-01-36
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-06	74	RPS-01-37
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-07	75	RPS-01-44
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-38
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-08	77	RPS-01-39
10	NPS-01-08	27	RPS-01-06	44	RPS-01-16	61	RPS-01-09	78	RPS-01-40
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-48	79	RPS-01-41
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-49	80	RPS-01-42
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81	RPS-01-43
14	RPS-01-02	31	RPS-01-09	48	RPS-01-08	65	RPS-01-13	82	RPS-01-15
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-51		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53		



### LEGEND

- PAVED ROAD OR TRAMWAY
- DRAINAGE DITCH
- S1119 EXISTING MONITORING WELLS
- RPM-01-02 NEW MONITORING WELLS
- SEDIMENT SAMPLE
- SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### PB CONCENTRATIONS

- >1000 µg/g
- 100 to 999 µg/g
- 30 to 99.9 µg/g
- ESTIMATED CONCENTRATION

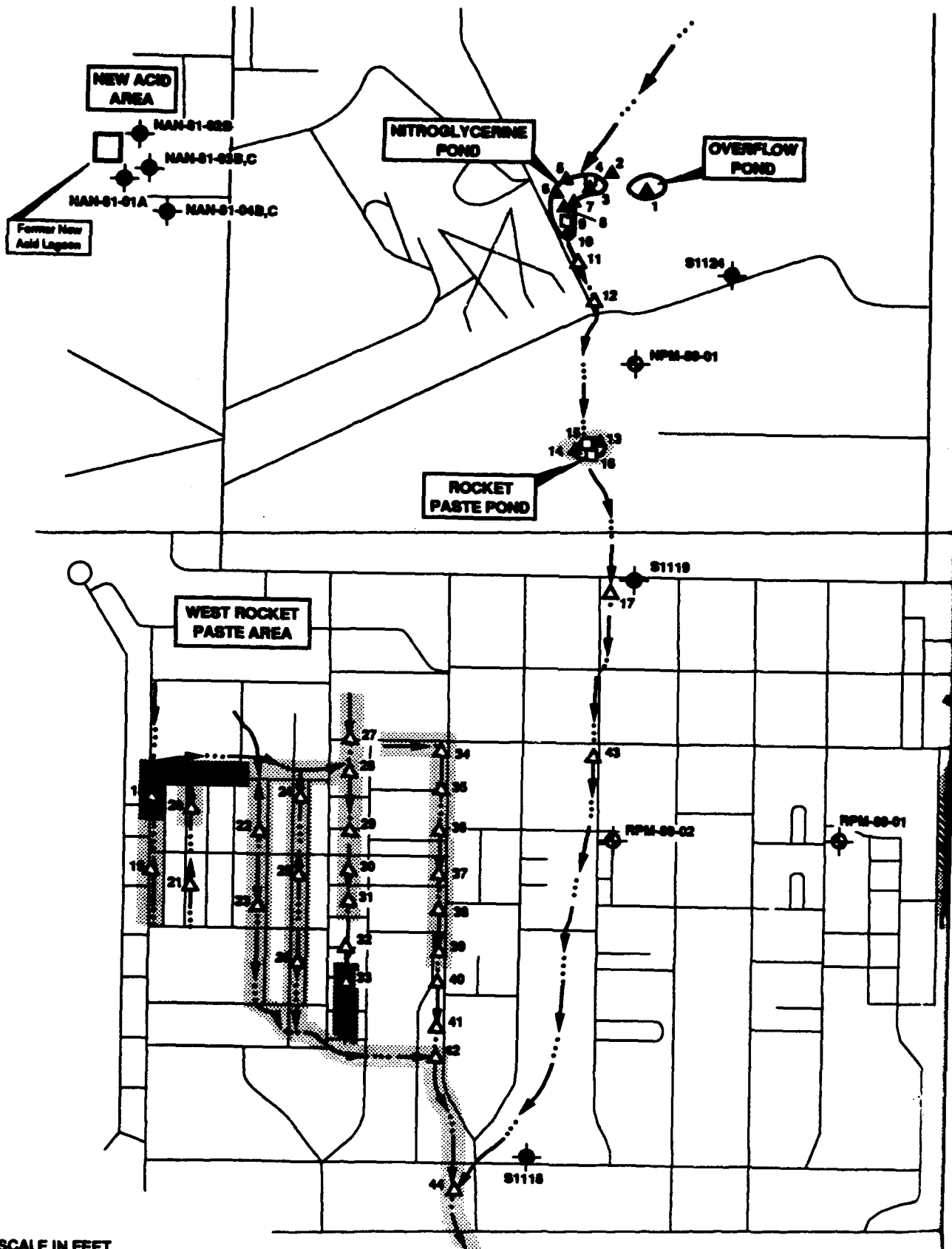
### NOTES:

1. SEE TABLE 8-9 OR APPENDIX K FOR CHEMICAL DATA SUMMARY.
2. CONCENTRATIONS <30 µg/g ARE CONSIDERED BACKGROUND. SEE SECTION 2.0.
3. CONCENTRATIONS ARE INDICATED AS ESTIMATED WHERE DATA POINTS ARE LIMITED.

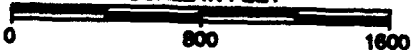
**FIGURE 8-7**  
**PB CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



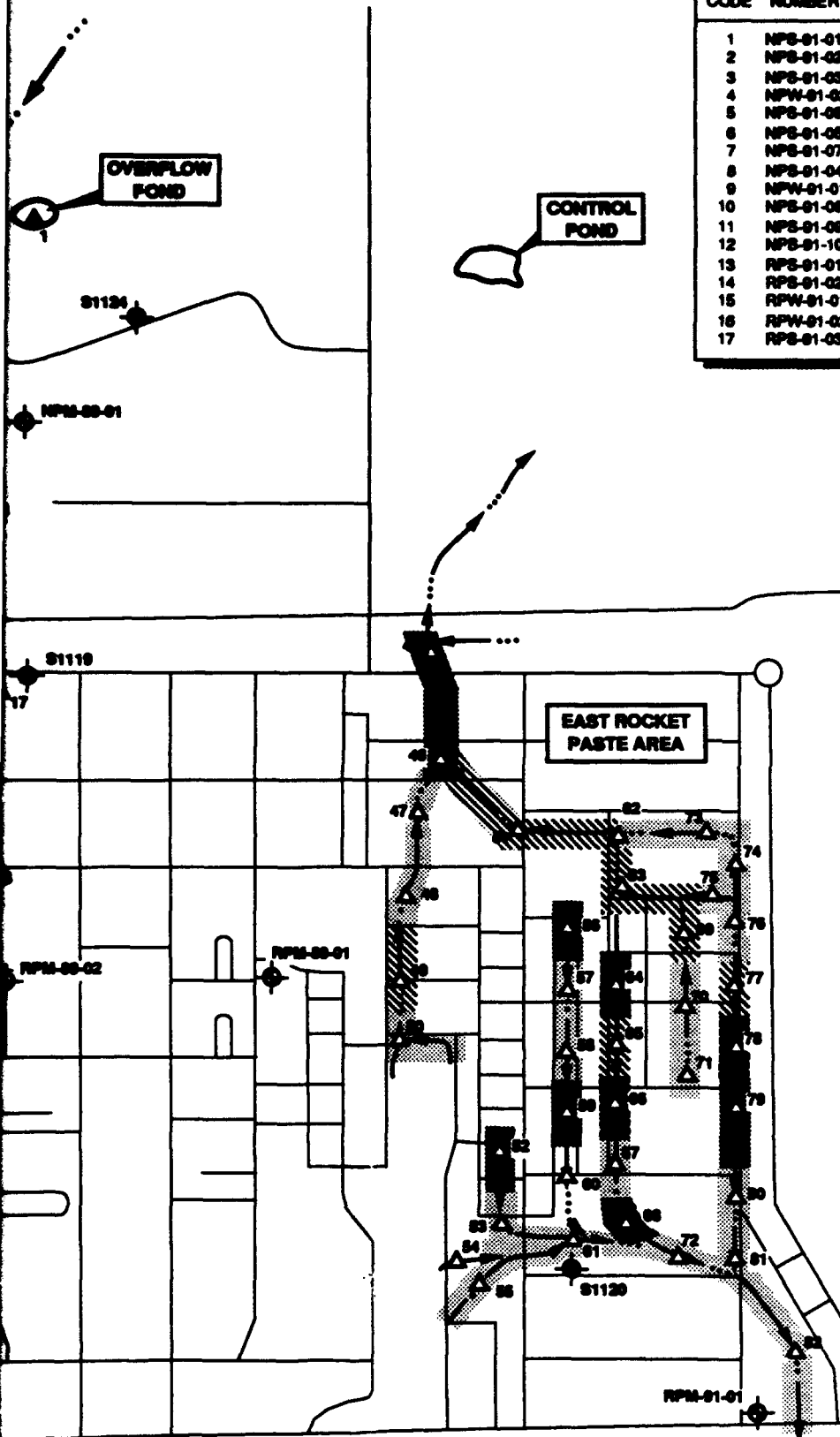


SCALE IN FEET





2



MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-00	69	RPS-01-00
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-01
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-02
4	NPW-01-02	21	RPS-01-33	38	RPS-01-20	55	RPS-01-03	72	RPS-01-03
5	NPS-01-06	22	RPS-01-30	39	RPS-01-21	56	RPS-01-04	73	RPS-01-04
6	NPS-01-05	23	RPS-01-31	40	RPS-01-22	57	RPS-01-05	74	RPS-01-05
7	NPS-01-07	24	RPS-01-28	41	RPS-01-23	58	RPS-01-06	75	RPS-01-06
8	NPS-01-04	25	RPS-01-29	42	RPS-01-24	59	RPS-01-07	76	RPS-01-07
9	NPW-01-01	26	RPS-01-26	43	RPS-01-25	60	RPS-01-08	77	RPS-01-08
10	NPS-01-08	27	RPS-01-27	44	RPS-01-26	61	RPS-01-09	78	RPS-01-09
11	NPS-01-09	28	RPS-01-23	45	RPS-01-27	62	RPS-01-10	79	RPS-01-10
12	NPS-01-10	29	RPS-01-24	46	RPS-01-28	63	RPS-01-11	80	RPS-01-11
13	RPS-01-01	30	RPS-01-25	47	RPS-01-29	64	RPS-01-12	81	RPS-01-12
14	RPS-01-02	31	RPS-01-26	48	RPS-01-30	65	RPS-01-13	82	RPS-01-13
15	RPW-01-01	32	RPS-01-28	49	RPS-01-31	66	RPS-01-14	83	RPS-01-14
16	RPW-01-02	33	RPS-01-27	50	RPS-01-32	67	RPS-01-15	84	RPS-01-15
17	RPS-01-03	34	RPS-01-05	51	RPS-01-33	68	RPS-01-16	85	RPS-01-16

**LEGEND**

— PAVED ROAD OR TRAMM

... DRAINAGE DITCH

S1119 EXISTING MONITORING WELL

RPM-01-02 NEW MONITORING WELL

▲ SEDIMENT SAMPLE

△ SURFACE SOIL SAMPLE

□ SURFACE WATER SAMPLE

**NNDPA CONCENTRATIONS**

▨ >1000 µg/g

▧ 100 to 999 µg/g

■ 10 to 99 µg/g

░ >CRL to 9.9 µg/g

**NOTES:**

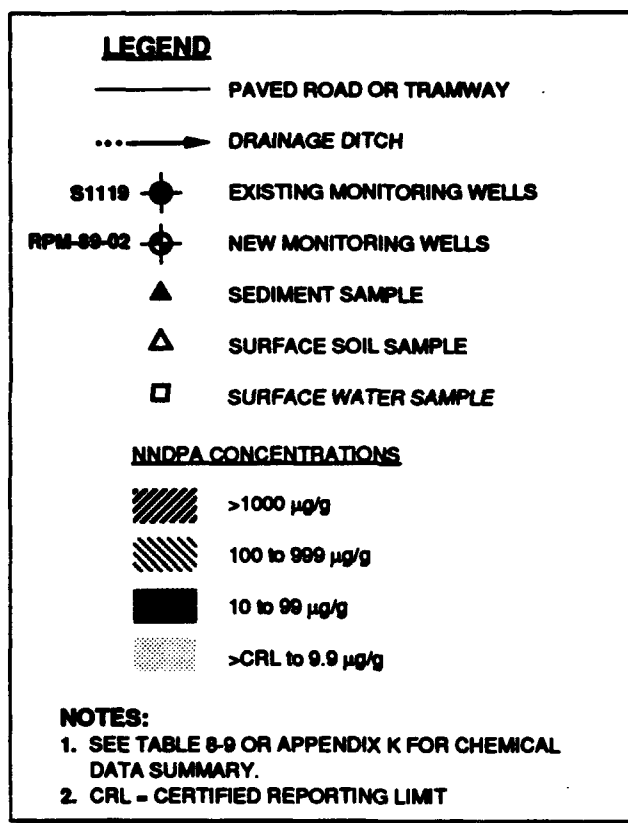
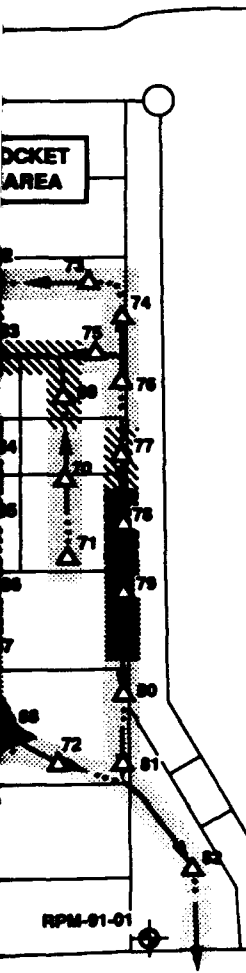
1. SEE TABLE 8-9 OR APPENDIX K FOR CRL DATA SUMMARY.

2. CRL = CERTIFIED REPORTING LIMIT

FM  
NNDPA CONCENT  
NITROGLYCERIN  
ROCKET PASTE AREA AND NEW AC  
REMEDIAL INVEST  
BADGER ARMY AMMUNITION  
ABB Environmental S

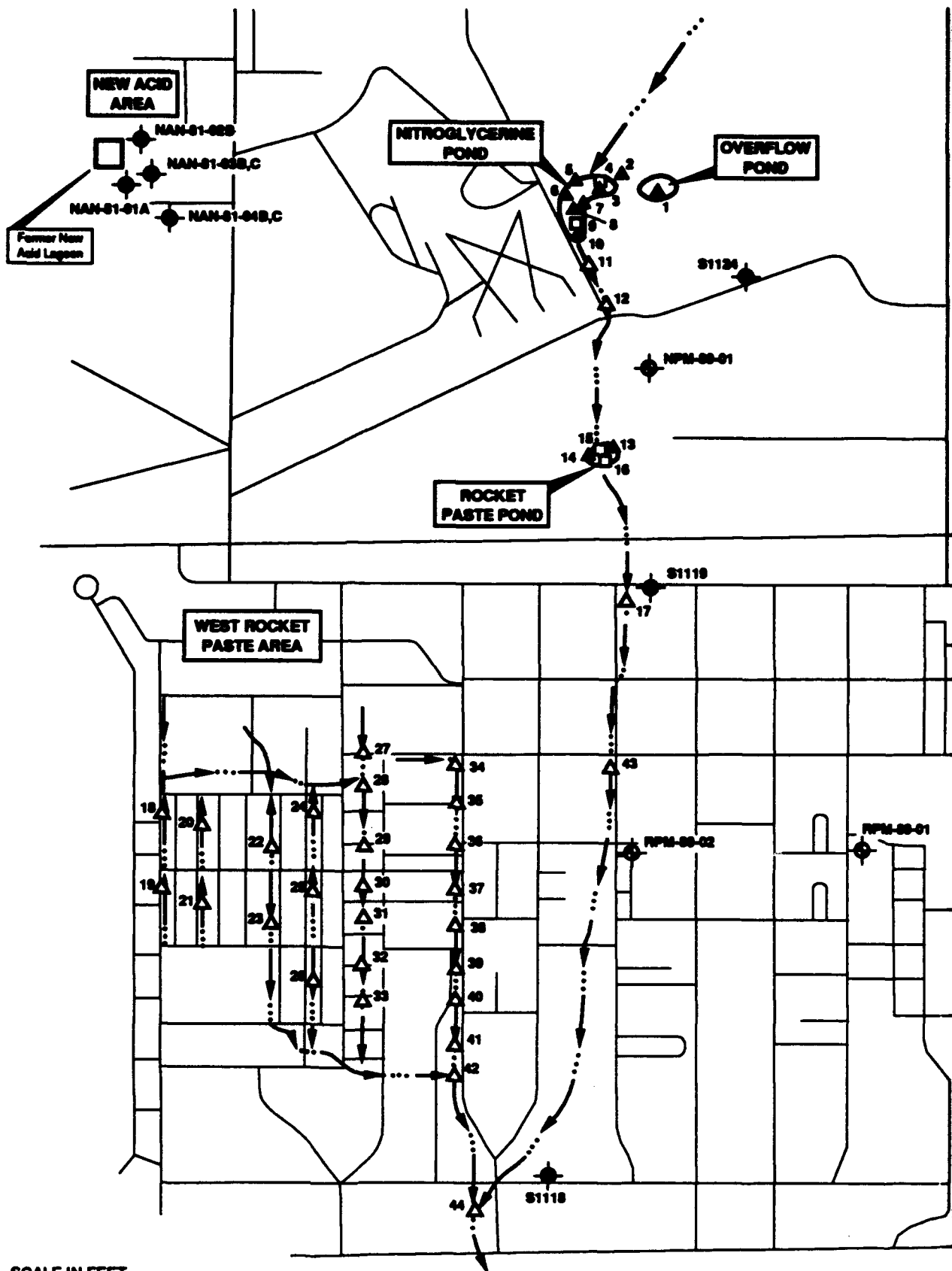


MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
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2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	63	RPS-01-01
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	64	RPS-01-02
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	65	RPS-01-03
5	NPS-01-08	22	RPS-01-30	39	RPS-01-20	66	RPS-01-05
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	67	RPS-01-58
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	68	RPS-01-57
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	69	RPS-01-14
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	70	RPS-01-58
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	71	RPS-01-59
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	72	RPS-01-48
12	NPS-01-10	29	RPS-01-24	46	RPS-01-64	73	RPS-01-49
13	RPS-01-01	30	RPS-01-25	47	RPS-01-65	74	RPS-01-50
14	RPS-01-02	31	RPS-01-09	48	RPS-01-08	75	RPS-01-13
15	RPW-01-01	32	RPS-01-26	49	RPS-01-67	76	RPS-01-51
16	RPW-01-02	33	RPS-01-27	50	RPS-01-68	77	RPS-01-52
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	78	RPS-01-53



**FIGURE 8-8**  
**NNDPA CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
 ABB Environmental Services, Inc.







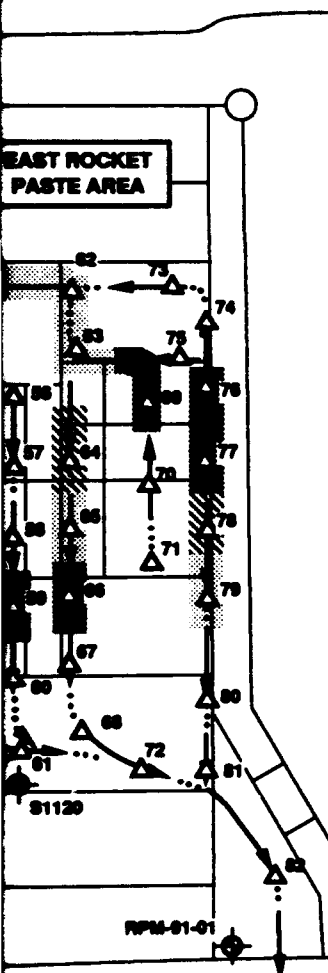
**TOTAL DNT CONCENTRATIONS  
NITROGLYCERINE  
ROCKET PASTE AREA AND NEW  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental**



MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-09	69	RPS-01-12
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-45
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-46
4	NPW-01-02	21	RPS-01-33	38	RPS-01-05	55	RPS-01-03	72	RPS-01-47
5	NPS-01-06	22	RPS-01-30	39	RPS-01-20	56	RPS-01-05	73	RPS-01-38
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-08	74	RPS-01-57
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-57	75	RPS-01-44
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-36
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-58	77	RPS-01-39
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-59	78	RPS-01-40
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-48	79	RPS-01-41
12	NPS-01-10	29	RPS-01-24	46	RPS-01-04	63	RPS-01-49	80	RPS-01-42
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81	RPS-01-43
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-13	82	RPS-01-15
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-51		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53		

CONTROL POND

EAST ROCKET PASTE AREA



### LEGEND

- PAVED ROAD OR TRAMWAY
- DRAINAGE DITCH
- S1119 EXISTING MONITORING WELLS
- RPS-01-01 NEW MONITORING WELLS
- SEDIMENT SAMPLE
- SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE

### TOTAL DNT CONCENTRATIONS

- >100 µg/g
- 10 to 99 µg/g
- >CRL TO 9.9 µg/g

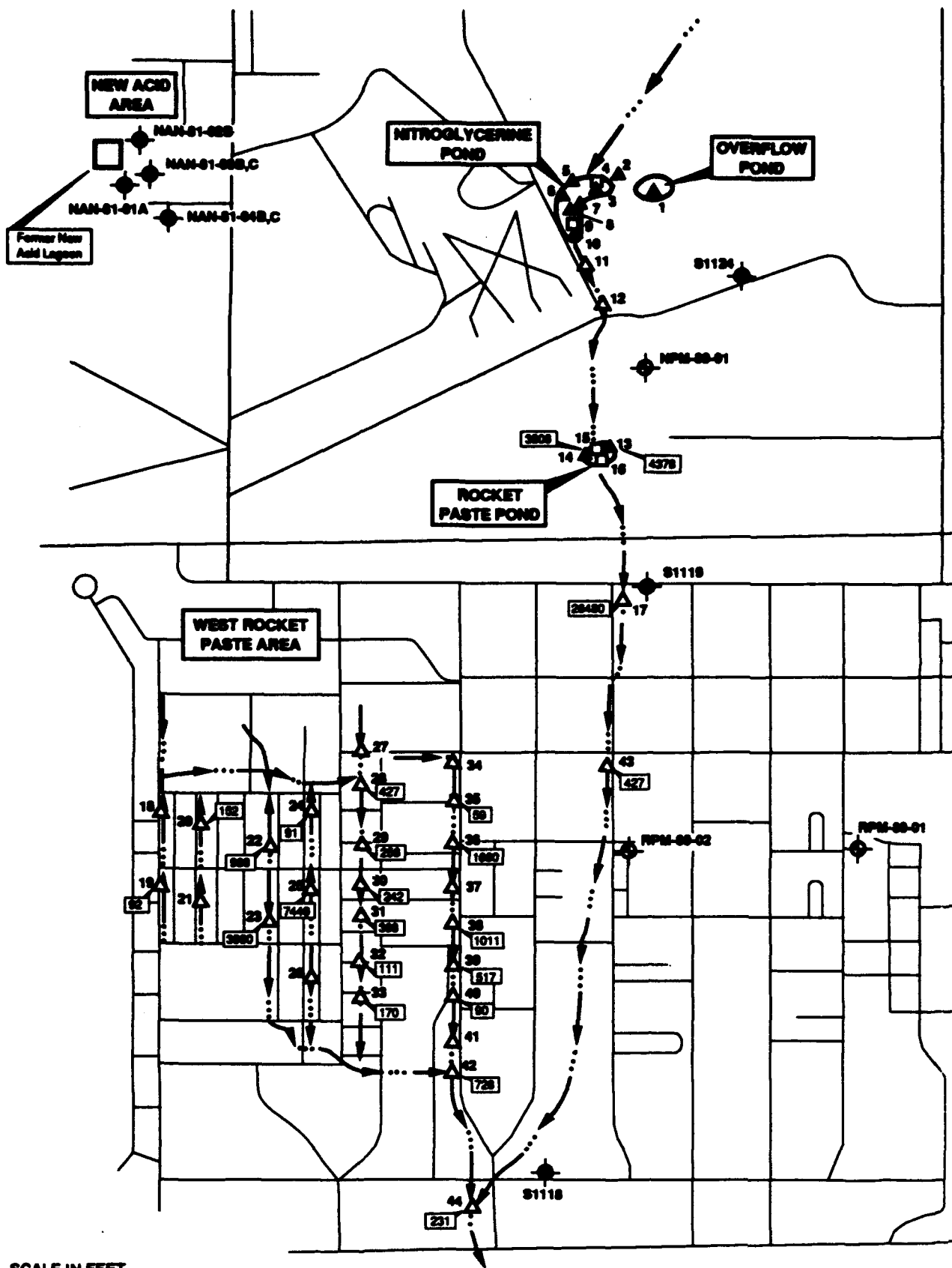
### NOTES:

- SEE TABLE 8-9 OR APPENDIX K FOR CHEMICAL DATA SUMMARY.
- CRL = CERTIFIED REPORTING LIMIT

**FIGURE 8-9**  
**TOTAL DNT CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

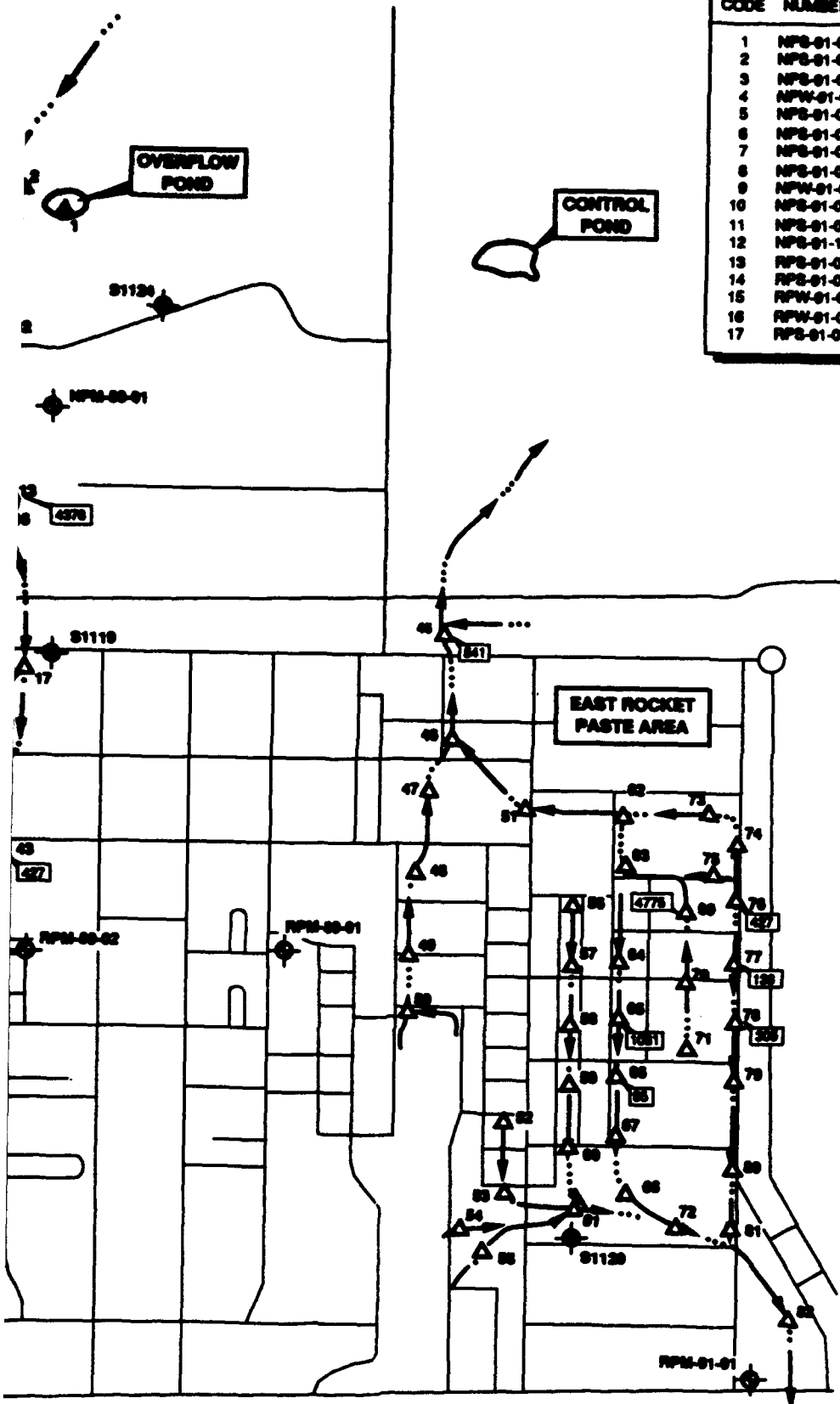
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**SCALE IN FEET**





MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-09
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02
4	NPW-01-02	21	RPS-01-33	38	RPS-01-08	55	RPS-01-03
5	NPS-01-05	22	RPS-01-30	39	RPS-01-20	56	RPS-01-05
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-06
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-07
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14
9	NPW-01-01	26	RPS-01-39	43	RPS-01-04	60	RPS-01-08
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-09
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-06
12	NPS-01-10	29	RPS-01-34	46	RPS-01-04	63	RPS-01-09
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-08
14	RPS-01-02	31	RPS-01-09	48	RPS-01-06	65	RPS-01-13
15	RPW-01-01	32	RPS-01-26	49	RPS-01-07	66	RPS-01-51
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53

**LEGEND**

- PAVED ROAD OR TRAIL
- ...—> DRAINAGE DITCH
- S1110 ● EXISTING MONITORING POINT
- RPM-00-02 ◆ NEW MONITORING WELL
- ▲ SEDIMENT SAMPLE
- △ SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE
- 61 □ PB CONCENTRATION (µg/L)

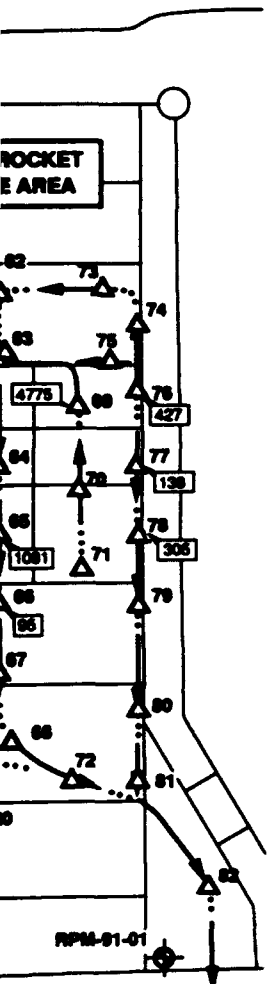
**NOTES:**

1. SEE TABLE 8-9 OR APPENDIX K FOR DATA SUMMARY.

F  
TCLP PB CONCEN  
NITROGLYCER  
ROCKET PASTE AREA AND NEW  
REMEDIAL INVE  
BADGER ARMY AMMUNITI  
ABB Environmental



MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER	MAP CODE	SAMPLE NUMBER
1	NPS-01-01	18	RPS-01-34	35	RPS-01-17	52	RPS-01-00	69	RPS-01-12
2	NPS-01-02	19	RPS-01-35	36	RPS-01-18	53	RPS-01-01	70	RPS-01-46
3	NPS-01-03	20	RPS-01-32	37	RPS-01-19	54	RPS-01-02	71	RPS-01-48
4	NPW-01-02	21	RPS-01-33	38	RPS-01-06	55	RPS-01-03	72	RPS-01-47
5	NPS-01-06	22	RPS-01-30	39	RPS-01-20	56	RPS-01-55	73	RPS-01-38
6	NPS-01-05	23	RPS-01-31	40	RPS-01-21	57	RPS-01-56	74	RPS-01-37
7	NPS-01-07	24	RPS-01-28	41	RPS-01-22	58	RPS-01-57	75	RPS-01-44
8	NPS-01-04	25	RPS-01-10	42	RPS-01-07	59	RPS-01-14	76	RPS-01-36
9	NPW-01-01	26	RPS-01-29	43	RPS-01-04	60	RPS-01-58	77	RPS-01-39
10	NPS-01-08	27	RPS-01-08	44	RPS-01-16	61	RPS-01-59	78	RPS-01-40
11	NPS-01-09	28	RPS-01-23	45	RPS-01-11	62	RPS-01-48	79	RPS-01-41
12	NPS-01-10	29	RPS-01-24	46	RPS-01-84	63	RPS-01-49	80	RPS-01-42
13	RPS-01-01	30	RPS-01-25	47	RPS-01-05	64	RPS-01-50	81	RPS-01-43
14	RPS-01-02	31	RPS-01-09	48	RPS-01-08	65	RPS-01-13	82	RPS-01-15
15	RPW-01-01	32	RPS-01-26	49	RPS-01-57	66	RPS-01-51		
16	RPW-01-02	33	RPS-01-27	50	RPS-01-08	67	RPS-01-52		
17	RPS-01-03	34	RPS-01-05	51	RPS-01-54	68	RPS-01-53		



**LEGEND**

- PAVED ROAD OR TRAMWAY
- DRAINAGE DITCH
- EXISTING MONITORING WELLS
- NEW MONITORING WELLS
- SEDIMENT SAMPLE
- SURFACE SOIL SAMPLE
- SURFACE WATER SAMPLE
- PB CONCENTRATION IN SAMPLE (µg/L)

**NOTES:**

- SEE TABLE 8-9 OR APPENDIX K FOR CHEMICAL DATA SUMMARY.

**FIGURE 8-10**  
**TCLP PB CONCENTRATIONS**  
**NITROGLYCERINE POND,**  
**ROCKET PASTE AREA AND NEW ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**  
ABB Environmental Services, Inc.



TABLE 9-1  
SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITES	PROGRAM ELEMENTS				
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING	SEDIMENT, SURFACE SOIL, AND SURFACE WATER SAMPLING
Oleum Plant and Oleum Plant Pond	--	--	3 new wells; 10 samples from 3 new and 2 existing wells	5 deep borings, 24 analytical samples; 8 shallow borings; 22 analytical samples	10 sediment samples 5 surface water samples
Ballistics Pond	--	--	4 samples from existing wells	--	--

Notes:

\* Includes 2 rounds of groundwater sampling



**TABLE 9-2**  
**SUMMARY OF BORINGS COMPLETED -**  
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

BORING NUMBER	DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)	TOTAL NUMBER OF SPLIT-SPOON SAMPLES	NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS	PURPOSE
<u>Oleum Plant</u> OPB-91-01 <sup>1</sup>	66	5	4	This deep boring was drilled at the former bulk sulfur storage area to characterize the type and vertical distribution of residual contamination.
OPB-91-06	12	3	3	These shallow borings were drilled in and around the Oleum Plant production facilities. The samples from these shallow borings will be used to characterize the vertical and areal extent of potential shallow soil contamination at the Oleum Plant production facility
OPB-91-07	12	3	3	
OPB-91-08	11	3	3	
OPB-91-09	12	3	3	
OPB-91-10	8	2	2	
OPB-91-11	12	3	3	These deep borings were drilled in the Oleum Plant Pond. They are located near the presumed outfall (02), at the edge of the pond (03), and near the edge of the apparent high waterline (04 and 05). These borings will be used in conjunction with sediment samples to characterize the areal and vertical distribution of residual soil contamination below the pond.
OPB-91-12	10	3	3	
OPB-91-13	9	2	2	
<u>Oleum Plant and Pond</u> OPB-91-02	68	10	5	
OPB-91-03	101	14	5	
OPB-91-04	92	13	5	
OPB-91-05	93	13	5	

**Notes:** <sup>1</sup>OPB-91-01 was first drilled using a hollow-stem auger. Boring encountered refusal at 12 feet, 7 feet, 5 feet. The boring was completed using the T1460 drive through casing technique.



**TABLE 9-3**  
**SUMMARY OF MONITORING WELLS INSTALLED -**  
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
<u>Oleum Plant and Oleum Plant Pond</u>						
OPM-89-01	Drill through casing hammer	88	837.8	20	Downgradient and southeast of the former sulfur storage area and old lagoon.	To provide horizontal definition of any potential plumes associated with the former sulfur storage or lagoon area.
OPM-89-02	Drill through casing hammer	118	764.6	20	Downgradient and approximately 600 feet southeast of the Oleum Plant.	To provide horizontal definition of any potential plumes from the Oleum Plant Pond.
OPM-89-03	Drill through casing hammer	162	765.7	20	Downgradient and approximately 1,200 feet southeast of the Oleum Plant.	To provide horizontal definition of any potential plumes from the Oleum Plant.

Notes:

MSL = Mean Sea Level

W0039213T 9/3



**TABLE 9-4**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	NEW WELLS	EXISTING WELLS
Oleum Plant and Oleum Plant Pond	OPM-89-01 OPM-89-02 OPM-89-03	S1132 S1151
Ballistics Pond		S1127 S1128
TOTAL WELLS	3	4



TABLE 9-5  
CHEMICAL ANALYSES PERFORMED ON SURFACE WATER SAMPLES -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	TAL		INORGANICS							ORGANICS			
	METALS	METALS	PBT	NH3N2	N2KJEL	SO4	CL	ALK	HARD	VOC	BN/A	NG	DNT
BALLISTICS POND													
BPW-91-01	—	1	1	—	—	1	1	1	1	1	1	—	—
BPW-91-02	—	1	1	—	—	1	1	1	1	1	1	—	—
BPW-90-01	1	—	1	—	—	1	1	1	1	—	—	—	—
BPW-90-02	1	—	1	—	—	1	1	1	1	—	—	—	—
BPW-90-03	1	—	1	—	—	1	1	1	1	—	—	—	—
TOTALS	3	2	5	0	0	5	5	5	5	2	2	0	0

NOTES:

BN/A = base-neutral and acid-extractable organics by GC/MS

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

GC/MS = Gas Chromatography/Mass Spectrometry

HPLC = High Performance Liquid Chromatography

METALS = AL, CA, FE, MG, NA, PB

NAM = nitroamines by GC

N2KJEL = Nitrogen by Kjeldahl Method

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)

TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

USA025 wk1



TABLE 9-8  
CHEMICAL ANALYSES PERFORMED ON SEDIMENT SAMPLES -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS																OTHER			ORGANICS						
	TOTAL METALS								TCLP METALS								ANIONS		NH3N2	TOC	pH	VOC	SNA	MG	NAM	DNT
	PP	AL	CA	NA	CD	CR	HG	PB	CD	CR	HG	PB	ANIONS	NIT	SO4											
OLEUM PLANT AND POND																										
OPS-01-01	-	-	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	-
OPS-01-02	-	-	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	-
OPS-01-03	-	-	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	-
OPS-01-04	-	-	1	1	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	-	-	-	-
BALLISTICS POND																										
BPS-01-01	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
BPS-01-02	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
BPS-01-03	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
BPS-01-04	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
BPS-01-05	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
BPS-01-06	-	1	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
TOTALS	0	6	4	4	0	0	0	0	6	0	0	0	0	10	10	6	4	4	6	6	0	0	0	0	0	0

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)

TAL = Toxic Analyte List (2) (AL, SS, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BNA = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrofluorene by HPLC

HPLC = High Performance Liquid Chromatography

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TABLE 9-7  
CHEMICAL ANALYSES PERFORMED ON SUBSURFACE SOIL SAMPLES -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS												INORGANICS						OTHER				ORGANICS					
	METALS						TCLP METALS						ANIONS		TOC	pH	TPHC	VOC	BN/A	MG	NAM	DNT						
	PP	TAL	CD	CR	HG	FE	NI	PB	CD	CR	HG	PB	NIT	SO4														
OLEUM PLANT AND POND																												
OPB-91-01	--	--	4	4	4	4	--	4	--	--	--	--	4	4	4	4	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-02	--	--	5	5	5	--	5	5	--	--	--	--	5	5	5	5	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-03	--	--	5	5	5	--	5	5	--	--	--	--	5	5	5	5	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-04	--	--	5	5	5	5	--	5	--	--	--	--	5	5	5	5	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-05	--	--	5	5	5	5	--	5	--	--	--	--	5	5	5	5	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-06	--	--	--	--	--	--	--	--	--	--	--	--	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-07	--	--	--	--	--	--	--	--	--	--	--	--	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-09	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
OPB-91-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTALS	0	0	24	24	24	14	10	24	0	0	0	0	30	46	24	24	24	0	0	0	0	0	0	0	0	0	0	0

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BN/A = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography

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TABLE 9-4  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS																	ORGANICS					TPH
	METALS							ANIONS			OTHER												
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	VOC	BN/A	NG	NAM	DNT	
BALLISTICS POND																							
S1127	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	-	-	-	-
S1128	-	-	-	-	-	-	-	-	-	-	B	B	B	B	B	B	B	-	B	-	-	-	-
OLEUM PLANT AND POND																							
OPM-89-01	-	-	1	1	1	1	B	B	-	B	B	B	B	B	B	B	-	B	-	-	-	-	-
OPM-89-02	-	-	1	1	1	1	B	B	-	B	B	B	B	B	B	B	-	B	-	-	-	-	-
OPM-89-03	-	-	1	1	1	1	B	B	-	B	B	B	B	B	B	B	-	B	-	-	-	-	-
S1132	-	-	1	1	1	1	B	B	-	B	B	B	B	B	B	B	-	B	-	-	-	-	-
S1151	-	-	1	1	1	1	B	B	-	B	B	B	B	B	B	B	-	B	-	-	-	-	-

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)  
VOC = volatile organic compounds by GC/MS  
GC/MS = Gas Chromatography/Mass Spectrometry  
BN/A = base-neutral and acid-extractable organics by GC/MS  
NAM = nitroamines by GC  
NT = 2,4- and 2,6-dinitrobenzene by HPLC  
PLC = High Performance Liquid Chromatography  
B = Analyzed in Both Rounds (One and Two).  
1 = Analyzed in Round One Only.

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**TABLE 9-9**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
OPM-89-03	0.9	$1 \times 10^{-1}$	Fine sand with gravel (SP) over gravel (GP)

**Notes:**

Hydraulic Conductivity Tests completed during March and November, 1989, and November and December 1991.

Field data and calculations are presented in Appendix I.

Values for hydraulic conductivities represent an averaged value of multiple tests performed on each well.

Water level recovery at these wells impacted by inertial effects, resulting in water level recovery above static water levels. Hydraulic conductivity measurements may be greater than the calculated values at these wells.

cm/sec = centimeters per second



**TABLE 9-10**  
**HORIZONTAL GROUNDWATER GRADIENTS**  
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

WELL PAIRS	HORIZONTAL GRADIENT (ft/ft) <sup>1</sup>	COMMENT
<u>Oleum Plant and Oleum Plant Pond</u>		
OPM-89-02 S1132	0.0004	Southerly and easterly flow vectors in deep regional system
DBN-89-04B	0.0004	Southerly and easterly flow vector in deep regional flow system
<u>Ballistics Pond</u>		
S1127 S1128	0.008	Southerly flow vector in shallow flow system

**Notes:**

<sup>1</sup> Gradient calculations are presented in Appendix H. All gradient calculations based on 12/13/89 water level measurements.  
ft/ft = feet per foot



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OPB-91-01	OPB-91-01	OPB-91-01	OPB-91-01	OPB-91-02	OPB-91-02	OPB-91-02	OPB-91-02	OPB-91-02	OPB-91-03
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/23/91	10/23/91	10/23/91	10/29/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91
DEPTH:	2.000	6.000	16.000	21.000	2.000	7.000	12.000	22.000	62.000	2.000
<b>Metals</b>										
CR	14.400	13.000	13.500	18.000	4.860	22.900	28.200	10.200	3.150	30.300
FE	16500.000	16400.000	11700.000	27300.000						
HG					0.115					
NI					4.210	16.000	12.000	13.400	6.640	23.100
PB	6.820	10.400	5.790	42.000	4.760	18.000	13.000	20.000	5.600	16.000
<b>Anions</b>										
NIT	1.680	1.980	1.680	1.280	1.680	6.190			1.110	1.130
SO4	8500.000	14000.000	2000.000	2600.000	60.700	220.000	58.300	12.100	7.640	27.640
<b>Indicator</b>										
PH	6.500	7.640	8.950	9.230	8.160	6.760	10.400	5.600	7.980	6.300
<b>Parameter</b>										
TOC	9120.000	4980.000	9230.000	8680.000	5840.000	13800.000	4660.000	975.000	3050.000	23100.000

Notes and flagging codes are presented at the end of this table.



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID.	OPB-91-03	OPB-91-03	OPB-91-03	OPB-91-03	OPB-91-03	OPB-91-04	OPB-91-04	OPB-91-04	OPB-91-04	OPB-91-04	OPB-91-04	OPB-91-04
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91	10/10/91
DEPTH:	6.000	11.000	21.000	101.000	2.640	2.000	6.000	11.000	21.000	91.000	2.000	2.000
Metals												
CR	22.000	2.050	4.060	2.640	2.640	21.300	25.800	21.500	8.090	7.120	21.600	21.600
FE	-	-	-	-	-	11200.000	22300.000	43600.000	8360.000	8270.000	18800.000	18800.000
HG	-	-	-	-	-	-	-	-	-	-	-	-
NI	15.400	6.420	3.960	-	-	-	-	-	-	-	-	-
PB	6.100	8.200	2.590	2.260	2.260	15.000	14.000	12.000	2.690	15.000	18.600	18.600
Anions												
NIT	-	1.380	1.430	1.340	1.340	1.230	1.340	1.960	1.320	1.910	-	-
SO4	230.000	89.700	380.000	-	-	39.900	17.600	11.100	-	15.900	110	110
Indicator												
PH	7.800	8.200	8.060	12.800	12.800	5.850	7.060	7.820	13.100	9.720	.960	.960
parameter												
TOC	2960.000	2170.000	1500.000	910.000	910.000	11900.000	4840.000	6340.000	6360.000	3930.000	11700.000	11700.000

Notes and flagging codes are presented at the end of this table.



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OPB-91-08	OPB-91-05	OPB-91-05	OPB-91-05	OPB-91-06	OPB-91-06	OPB-91-06	OPB-91-07	OPB-91-07	OPB-91-07
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/10/91	10/10/91	10/10/91	10/10/91	10/11/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91
DEPTH:	7,000	12,000	22,000	92,000	2,000	7,000	12,000	2,000	7,000	11,000
Metals										
CR	26,300	9,130	6,450	4,970						
FE	34100.000	11700.000	7350.000	5770.000						
HG										
NI										
PB	15,000	13,000	13,000	2,300						
Anions										
NIT	1,800	1,590	1,260	1,180	2,140	1,340	1,980	3,460	1,580	2,120
SO4	12,800	7,910								
Indicator										
PH	7,350	9,290	9,670	9,240						
parameter	1700.000	3670.000	5860.000	13300.000						
TOC										

Notes and flagging codes are presented at the end of this table.



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OPB-91-08	OPB-91-08	OPB-91-08	OPB-91-08	OPB-91-09	OPB-91-09	OPB-91-09	OPB-91-10	OPB-91-10	OPB-91-11	OPB-91-11
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91
DEPTH:	2,000	7,000	11,000	2,000	6,000	12,000	2,000	7,000	2,000	2,000	6,000
Metals											
CR											
FE											
HG											
NI											
PB											
ANIONS											
NIT											
SO4	1800.000	79.000	110.000	-	33.900	6.520	-	-	-	-	24.900
Indicator											
parameter											
PH											
TOC											

Notes and flagging codes are presented at the end of this table.



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OPB-91-11	OPB-91-12	OPB-91-12	OPB-91-12	OPB-91-13	OPB-91-13	OPB-91-13
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91	10/23/91
DEPTH:	11,000	2,000	6,000	11,000	2,000	2,000	6,000
Metals							
	CR						
	FE						
	HG						
	NI						
	PB						
	NIT						
	SO4						
Anions							
	190,000	1000,000	1400,000	3400,000	-	-	310,000
Indicator parameter							

Notes and flagging codes are presented at the end of this table.



TABLE 9-11  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
OLEUM PLANT AND OLEUM PLANT POND/ BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results

USATHIAMA chemical codes are defined in the RI Glossary Report



TABLE 9-12  
SUMMARY OF SEDIMENT CHEMICAL DATA-  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	BPS-91-01	BPS-91-02	BPS-91-03	BPS-91-04	BPS-91-05	BPS-91-06	OPS-91-01	OPS-91-02	OPS-91-03	OPS-91-04
Sample Type:	POND	POND	POND	POND	POND	POND	POND	POND	POND	POND
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/02/91	10/02/91	10/02/91	10/02/91	10/02/91	10/02/91	10/03/91	10/03/91	10/03/91	10/03/91
DEPTH:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SVOCs	B2HP	1.270	-	6.100	-	-	-	-	-	-
PHANTR	AL	-	-	0.428	-	-	-	-	-	-
Metals	CA	17200.000	22300.000	58000.000	10200.000	19700.000	36900.000	4380.000	4700.000	4730.000
	NA	-	-	-	-	-	120.000	-	67.200	70.000
	PB	33.000	19.000	54.000	2.070	3.240	15.500	14.000	45.000	50.000
Anions	NIT	5.160	-	-	-	-	590.000	300.000	160.000	230.000
	SO4	62.700	63.900	490.000	76.400	77.700	-	-	-	-
Indicator	NH3	13.900	23.800	71.200	17.700	-	13.200	8.200	11.800	7.540
parameter	PH	-	-	-	-	-	23400.000	32300.000	37400.000	25400.000
	TOC	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 9-12  
SUMMARY OF SEDIMENT CHEMICAL DATA-  
OLEUM PLANT AND OLEUM PLANT POND/ BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

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TABLE 9-13  
SUMMARY OF SURFACE WATER CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	BPW-90-01	BPW-90-02	BPW-90-03	BPW-91-01	BPW-91-02
Sample Type:	POND	POND	POND	POND	POND
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	09/27/90	09/27/90	09/27/90	10/02/91	10/02/91
DEPTH:	1.0	7.0	12.0	0.000	0.000
Metals	AL	930.00	1080.00	180.000	123.000
	BA			36.700	34.600
	CA	6190.00	6280.00	6510.000	6260.000
	FE	879.00	1040.00	315.000	217.000
	K			1490.000	1940.000
	MG	3030.00	3110.00	2920.000	2810.000
	MN			79.000	76.800
	NA	3600.00	3550.00	3780.000	3580.000
	V			5.230	-
	ZN			67.900	35.400
Anions	CL	2980.00	2930.00	3750.000	4050.000
	NIT	-	11.223	51.400	43.100
	SO4	12000.00	12000.00	14000.000	15000.000
	ALK	16000	18000	21100	21100
Indicator parameter	HARD	27000	27600	28900	29100
	pH(1)	8.6	9.0	9.0	7.3
	Sp.Cond.(2)	76	68	75	206
					204

Notes and flagging codes are presented at the end of this table.



TABLE 9-13  
SUMMARY OF SURFACE WATER CHEMICAL DATA-  
OLEUM PLANT AND OLEUM PLANT POND/ BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

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TABLE 9-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OPM-89-01	OPM-89-02	OPM-89-03	S1127	S1128
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/05/91	11/24/91	12/06/91	12/03/91	04/13/92
ROUND:	ONE	TWO	ONE	ONE	TWO
VOCs	4.510 P	6.270 B	4.310 P	4.900 P	4.410 P
Metals	100000	100000	52000	480000	68000
	8.17	-	5.59	-	-
	-	120000	-	16000	11000
Anions	680	530	1400	620	810
CL	110000	130000	2600 P	2400 P	9500
SO4	200000	170000	28000	28000	74000
Indicator	204000	254000	200000	174000	210000
parameter	450000	476000	234000	228000	396000
TDS	608000	701000	264000	255000	339000
TOC					
pH(1)	7.5	6.6	7.7	7.6	7.8
Sp. Cond. (2)	972	466	385	457	545
				242	184
				235	207

Notes and flagging codes are presented at the end of this table.



TABLE 9-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	S1132	WELL	S1151
Sample Type:	CH2CL2	UCL	UCL
UNITS:	58000	56000	70000
DATE SAMPLED:	12/05/91	04/09/92	04/08/92
ROUND:	ONE	TWO	TWO
VOCs	4.710 P	4.220 P	4.120 P
Metals	CA	56000	65000
	CR	6.31	7.27
	NA	3130. T	11000
	NIT	560	1200
	CL	2500 X	2700 P
	SO4	34000	32000
	ALK	192000	346000
Indicator	HAARD	238000	252000
parameter	TDS	269000	268000
	pH(1)	8.0	6.0
	Sp. Cond.(2)	442	425
			568
			491

Notes and flagging codes are presented at the end of this table.



TABLE 9-14  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
OLEUM POND AND OLEUM PLANT POND/ BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

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**TABLE 9-15**  
**COMPOUNDS OF POTENTIAL CONCERN**  
**OLEUM PLANT AND OLEUM PLANT POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUNDS OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION		
	SURFACE SOIL ( $\mu\text{g/g}$ )	SUBSURFACE SOIL <sup>2</sup> ( $\mu\text{g/g}$ )	SEDIMENT <sup>3</sup> ( $\mu\text{g/g}$ )
CR	14.4	30.3	--
HG	--	0.115	--
NI	--	23.1	--
NIT	3.46	6.19	50
SO4	8,500	14,000	590

**Notes:**

-- = Not identified as a compound of potential concern

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = microgram per kilogram; equivalent to parts per million (ppm)

<sup>1</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from borings OPB-91-01 and OPB-91-06 through OPB-91-05.

<sup>2</sup> Assessment of subsurface soil contamination (2 to 12 feet) was performed using samples from borings OPB-91-01 through OPB-91-05.

<sup>3</sup> Assessment of sediment contamination was performed using samples OPS-91-01 through OPS-91-04.



**TABLE 9-16**  
**SUMMARY OF RISK ESTIMATES**  
**OLEUM PLANT AND OLEUM PLANT POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Current and Future Grounds Maintenance Worker	Soil Ingestion	NA	0.000003
	Inhalation of Particulates and Vapors	<u>NA</u>	<u>ND</u>
	Total Grounds Maintenance Worker	NA	0.000003
Future Residential	Soil Ingestion	NA	0.0005
Future Construction Worker	Soil Ingestion	ND	0.02
	Inhalation of Particulates	<u><math>4 \times 10^{-6}</math></u>	<u>0.0002</u>
	Total for Construction Worker	$4 \times 10^{-6}$	0.02
Future Child Playing	Ingestion of Sediment	NA	0.04

**Notes:**

ND = not determined - toxicity factors not available for compounds of potential concern  
 NA = not applicable - no carcinogenic compounds of potential concern



**TABLE 9-17**  
**COMPOUNDS OF POTENTIAL CONCERN**  
**BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUNDS OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION	
	SEDIMENT <sup>1</sup> ( $\mu\text{g/g}$ )	SURFACE WATER <sup>2</sup> ( $\text{mg/l}$ )
AL	58,000	0.18
B2EHP	6.1	--
BA	--	0.0367
CL	--	4.05
MN	--	0.0791
NH3	215	--
NIT	5.16	0.0514
PB	54	--
PHANTR	0.428	--
SO4	490	15
V	--	0.00523
ZN	--	0.0679

**Notes:**

-- = Not identified as a compound of potential concern

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm)

$\text{mg/l}$  = milligrams per liter

<sup>1</sup> Assessment of sediment contamination was performed using samples BPS-91-01 through BPS-91-06.

<sup>2</sup> Assessment of surface water contamination was performed using samples BPW-91-01 and BPW-91-02.



**TABLE 9-18**  
**SUMMARY OF RISK ESTIMATES**  
**BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER Risk	HAZARD INDEX
Future Child Playing	Ingestion of Sediment	$5 \times 10^{-9}$	0.0001
	Ingestion of Surface Water	NA	0.00007
	Dermal Contact with Surface Water	<u>NA</u>	<u>0.00007</u>
	Total for Child Playing	$5 \times 10^{-9}$	0.0002

**Notes:**

NA = not applicable - no carcinogenic compounds of potential concern



**TABLE 9-19**  
**COMPARISON OF GROUNDWATER TO STANDARDS -**  
**UNITS:  $\mu\text{g}/\text{l}$**   
**OLEUM PLANT AND OLEUM PLANT POND/BALLISTICS POND**

**REMEDIAL INVESTIGATION  
 BADGER ARMY AMMUNITION PLANT**

COMPOUNDS OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
CL	14:14	130,000	1,910	250,000(a)	-	-	-	-
CR	5:10	8.17	5.59	100	100	50(c)	5(c)	-
NA	6:10	120,000	3,130	20,000(b)	-	-	-	-
NIT	14:14	1,500	290	10,000	10,000	10,000	2,000	-
SO4	14:14	200,000	1,200	250,000(a)	-	250,000(d)	125,000(d)	-

**Sources:**

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards - Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of  $10^{-6}$  or HI of 1 (see Subsection 4.5 for details).

**Notes:**

- (a) Secondary drinking water standard, suggested level.
- (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
- (c) WI proposing change to ES =  $100 \mu\text{g}/\text{l}$  and PAL =  $10 \mu\text{g}/\text{l}$
- (d) Value for protection of public welfare (usually aesthetic concerns) rather than for protection of public health.

$\mu\text{g}/\text{l}$	=	micrograms per liter
SDWA	=	Safe Drinking Water Act
MCL	=	Maximum Contaminant Level
MCLG	=	Maximum Contaminant Level Goal
WI	=	Wisconsin
ES	=	Enforcement Standard
PAL	=	Preventive Action Limit
TT	=	Treatment technique requirement in effect
		Copper action level = $1,300 \mu\text{g}/\text{l}$ ; Lead action level = $15 \mu\text{g}/\text{l}$



TABLE 9-20  
ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -  
OLEUM PLANT AND OLEUM PLANT POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil</u> <sup>C</sup>		
NIT	3:3	3.46
SO4	3:9	8,500
<u>Sediment</u> <sup>D</sup>		
NIT	4:4	0
SO4	4:4	590

Notes:

- <sup>A</sup> Constituents selected based on criteria presented in Tables Q-21 and Q-22 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>C</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from borings OPB-91-01 and OPB-91-06 through OPB-91-13.
- <sup>D</sup> Assessment of sediment contamination was performed using samples OPS-91-01 through OPS-91-04.



**TABLE 9-21**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup> -**  
**BALLISTICS POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Water<sup>C</sup></u>		
AL	2:2	180
BA	2:2	36.7
CL	5:5	4,050
FE	2:2	315
MN	2:2	79.1
NIT	3:5	51.4
SO4	5:5	15,000
V	1:2	5.23
ZN	2:2	67.9
<u>Sediment<sup>D</sup></u>		
AL	6:6	58,000
B2EHP	2:6	6.1
NH3	5:6	215
NIT	1:6	5.16
PB	6:6	54
PHANTR	1:6	0.428
SO4	6:6	490

**Notes:**

- <sup>A</sup> Constituents selected based on criteria presented in Tables Q-23 and Q-24 and discussed in Section 5.0.
- <sup>B</sup> 95th percentile or maximum; units in  $\mu\text{g}/\text{l}$  (surface water) and  $\mu\text{g}/\text{g}$  (sediment).
- <sup>C</sup> Assessment of surface water contamination was performed using samples BPW-91-01 and BPW-91-02.
- <sup>D</sup> Assessment of sediment contamination was performed using samples BPS-91-01 through BPS-91-06.



**TABLE 9-22**  
**RISK EVALUATION FOR AQUATIC RECEPTORS**  
**OLEUM PLANT POND**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	EXPOSURE POINT CONCENTRATION <sup>a</sup>	RTV <sup>b</sup>	HAZARD QUOTIENT <sup>c</sup>
<u>Sediment</u>			
NIT	50	545	0.09
SO4	590	NA	--

**Notes:**

- <sup>a</sup> Analytical results presented in Tables Q-21 and Q-22.
- <sup>b</sup> Reference Toxicity Value (RTV) derived from available quality criteria and effects threshold levels as presented in Table Q-3.
- <sup>c</sup> Calculated by dividing the exposure point concentration by the RTV; values in excess of 1.0E+00 indicate that the protective RTV was exceeded by environmental concentrations.

NA = none available.



**TABLE 9-23**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS**  
**OLEUM PLANT**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>a</sup>	
	ACUTE RISK <sup>b</sup>	CHRONIC RISK <sup>c</sup>
Short-tailed shrew	1.2E+00	1.2E+01
Eastern meadowlark	7.6E-02	7.0E-01
Garter snake	5.6E-02	5.2E-01
Red fox	2.2E-02	4.0E-03
Red-tailed hawk	6.0E-02	5.6E-03

**Notes:**

- <sup>a</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dose by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-57 and R-58 for acute and chronic exposure respectively.
- <sup>b</sup> Based on comparison to acute RTVs.
- <sup>c</sup> Based on comparison to chronic RTVs.



TABLE 9-24  
RISK EVALUATION FOR AQUATIC RECEPTORS  
BALLISTICS POND

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUND	EXPOSURE POINT CONCENTRATION <sup>a</sup>	RTV <sup>a</sup>	HAZARD QUOTIENT <sup>c</sup>
<u>Surface Water</u>			
AL	180	748	0.24
BA	36.7	1,360	0.027
CL	4,050	230,000	0.043
FE	315	1,000	.315
MN	79.1	100	0.79
NIT	51.4	5,000	0.01
SO4	15,000	1,060,000	0.014
V	5.23	200	0.026
ZN	67.9	49.59	1.4
<u>Sediment</u>			
AL	58,000	NA	--
B2EHP	6.1	NA	--
NH3	215	75	2.9
NIT	5.16	545	0.0095
PB	54	50	1.1
PHANTR	0.428	1,390	0.00031
SO4	490	NA	--

Notes:

Analytical results presented in Tables Q-23 and Q-24.

Reference Toxicity Value (RTV) derived from available quality criteria and effects threshold levels as presented in Table Q-3.

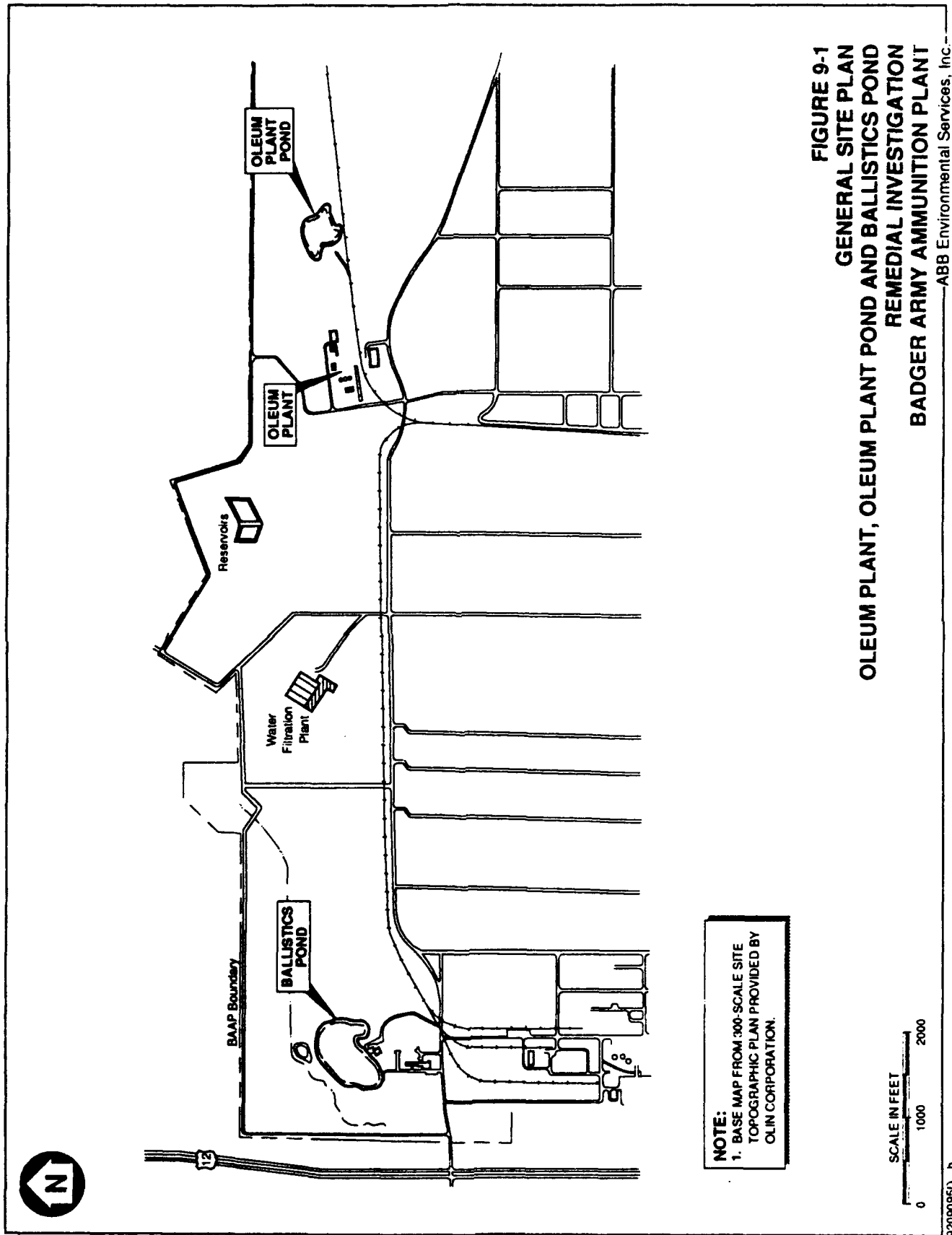
Calculated by dividing the exposure point concentration by the RTV; values in excess of 1.0E+00 indicate that the protective RTV was exceeded by environmental concentrations.

A = none available.

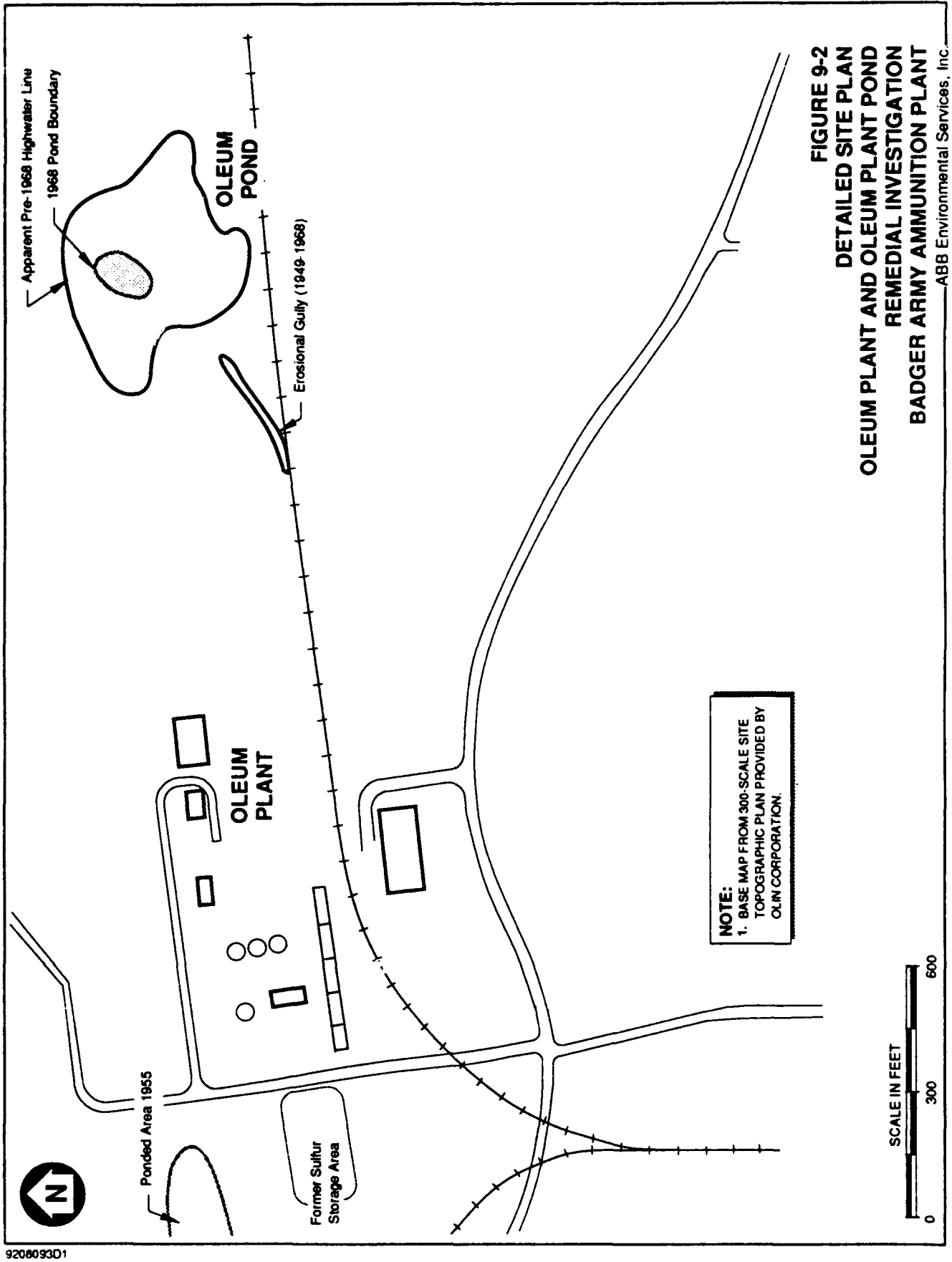


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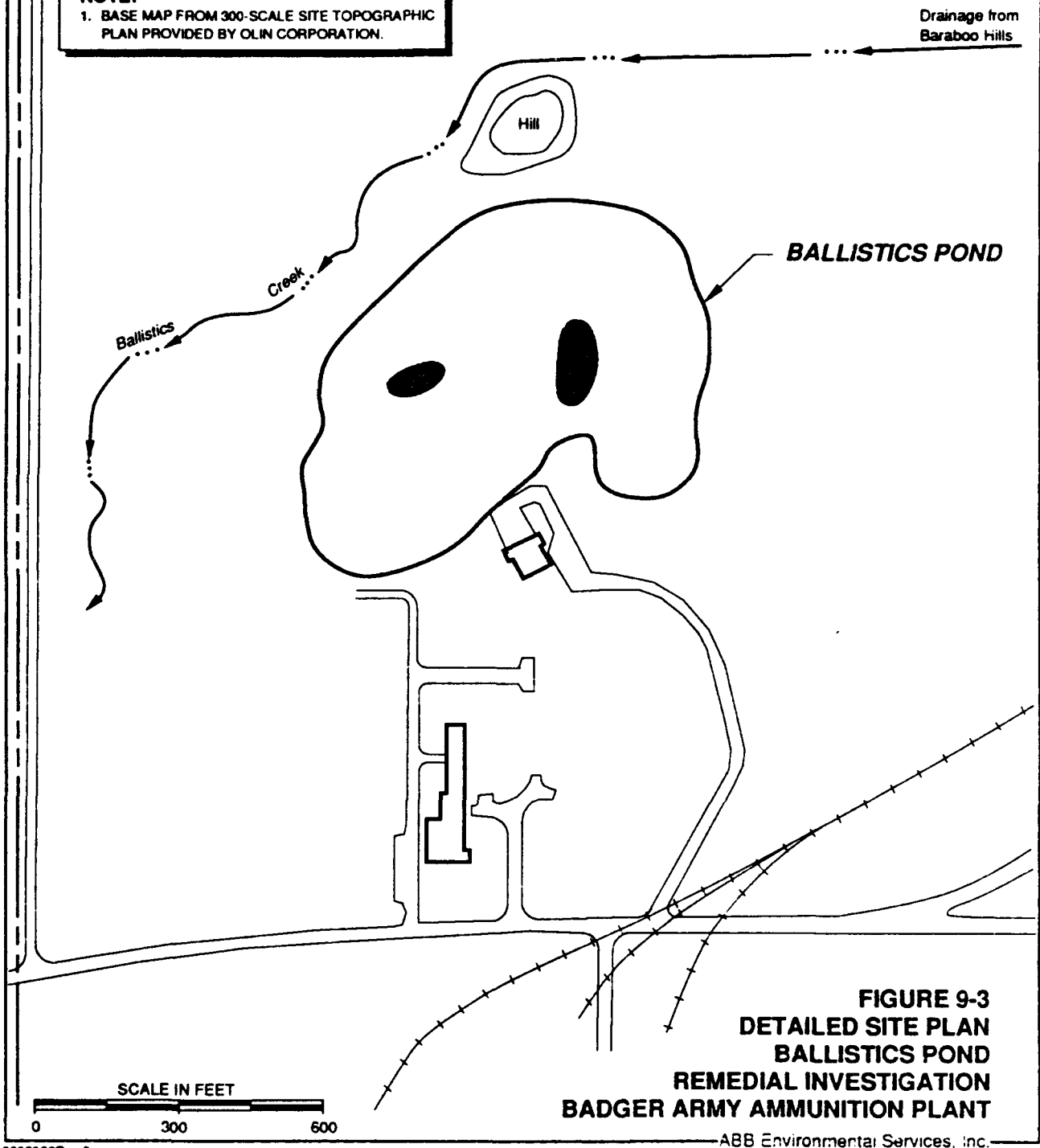


**LEGEND**

- RAILROAD TRACKS
- EXTENT OF BALLISTICS POND (1991)
- 1949 POND BOUNDARY

**NOTE:**

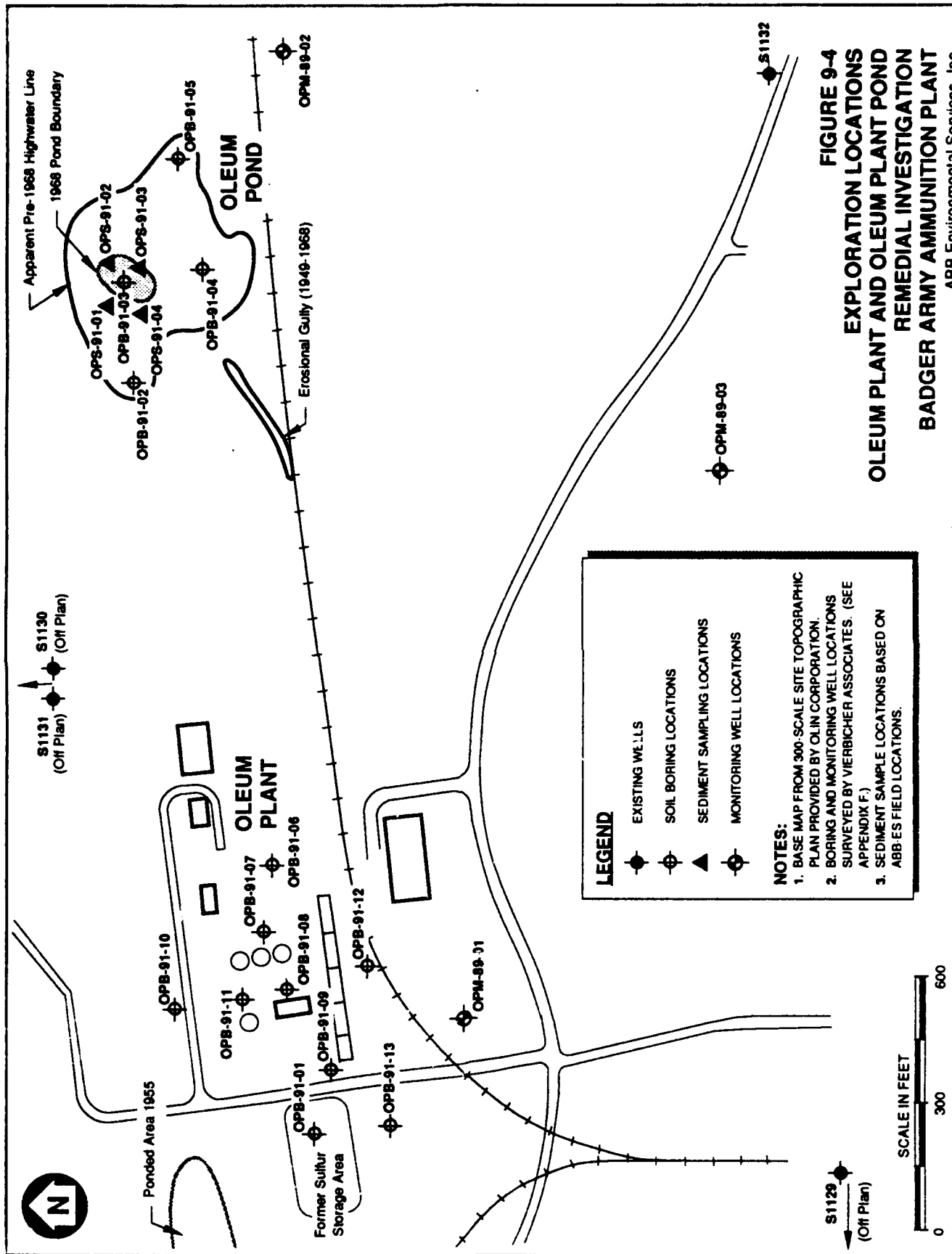
1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.



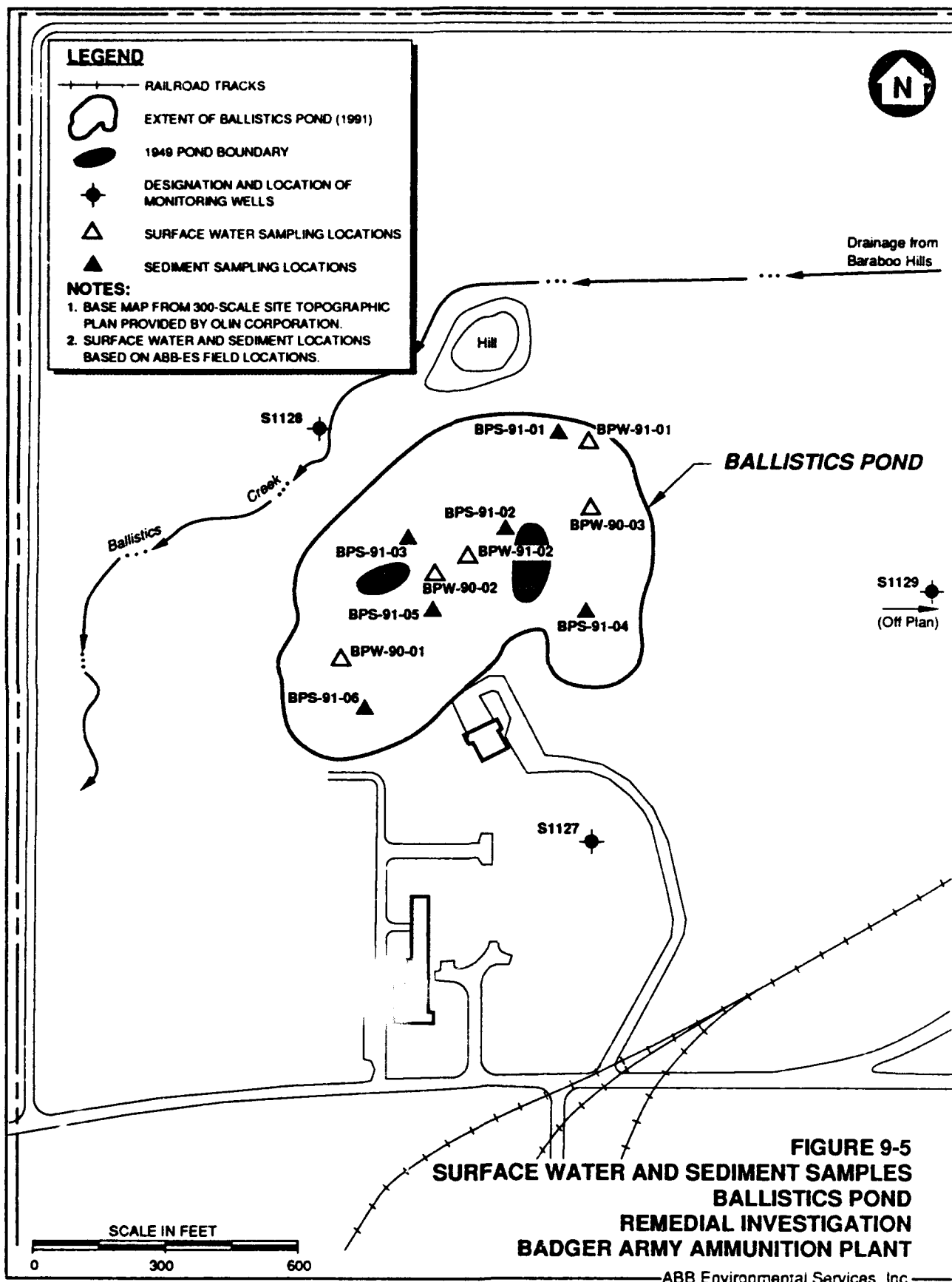
**FIGURE 9-3  
DETAILED SITE PLAN  
BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.

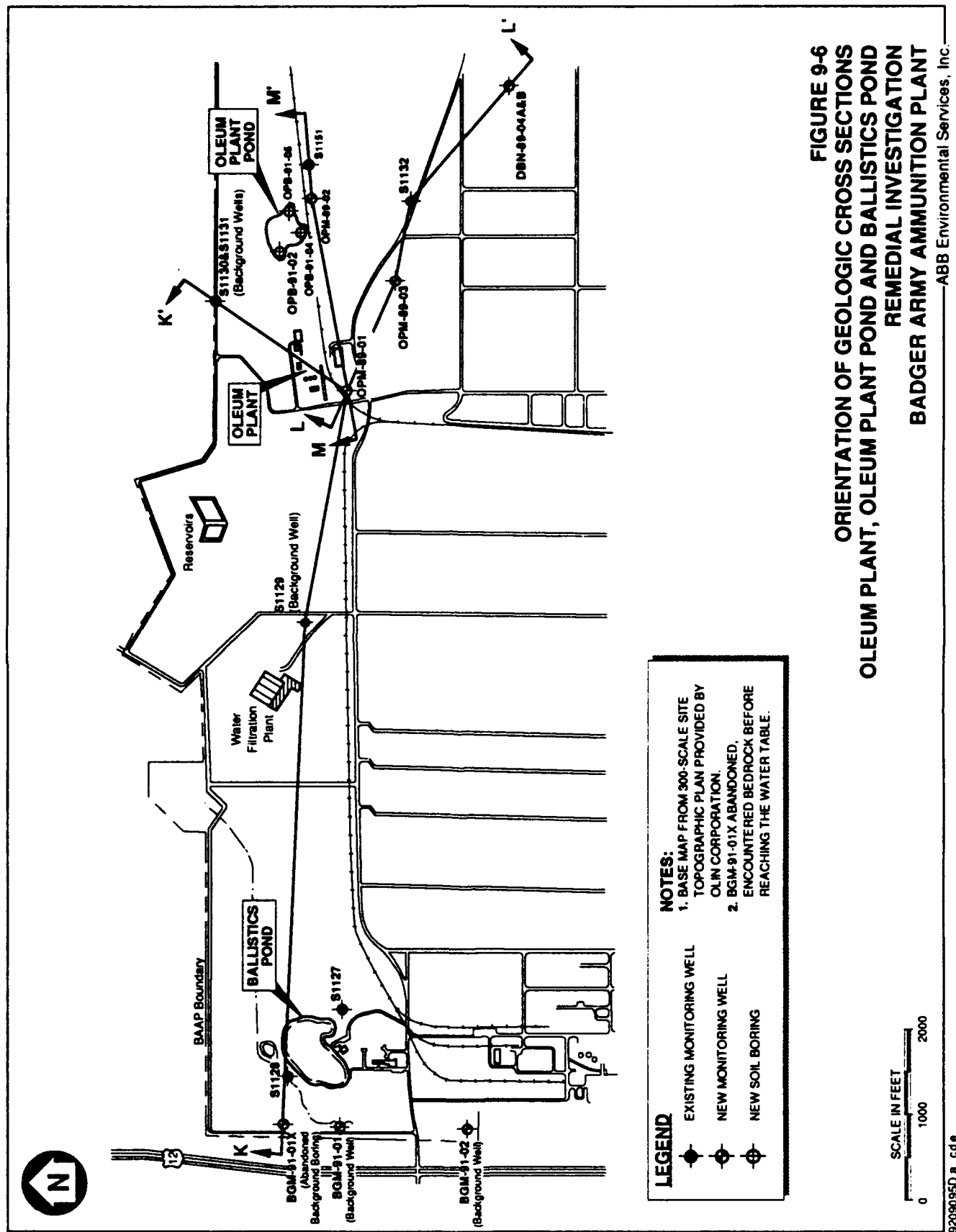




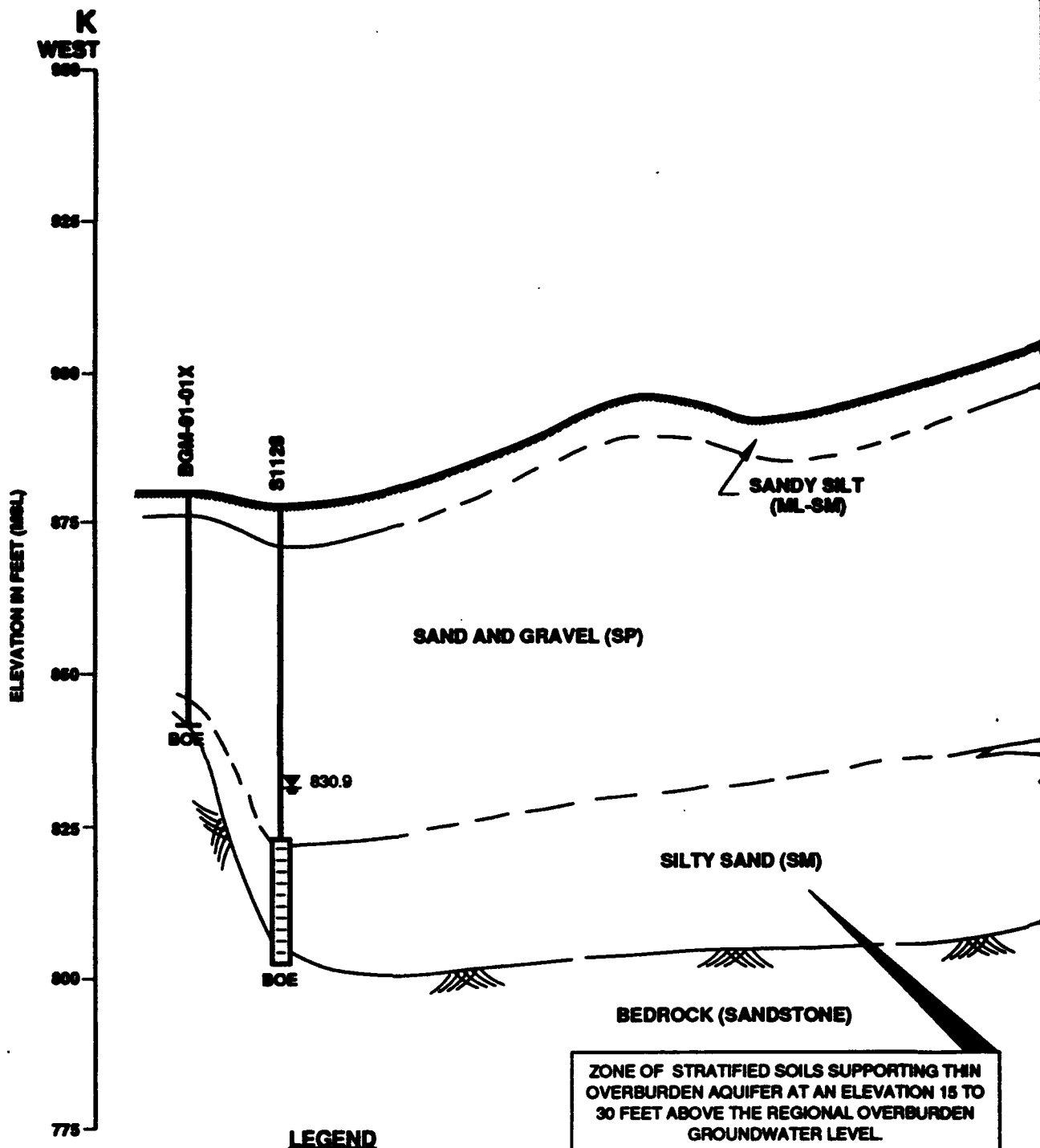












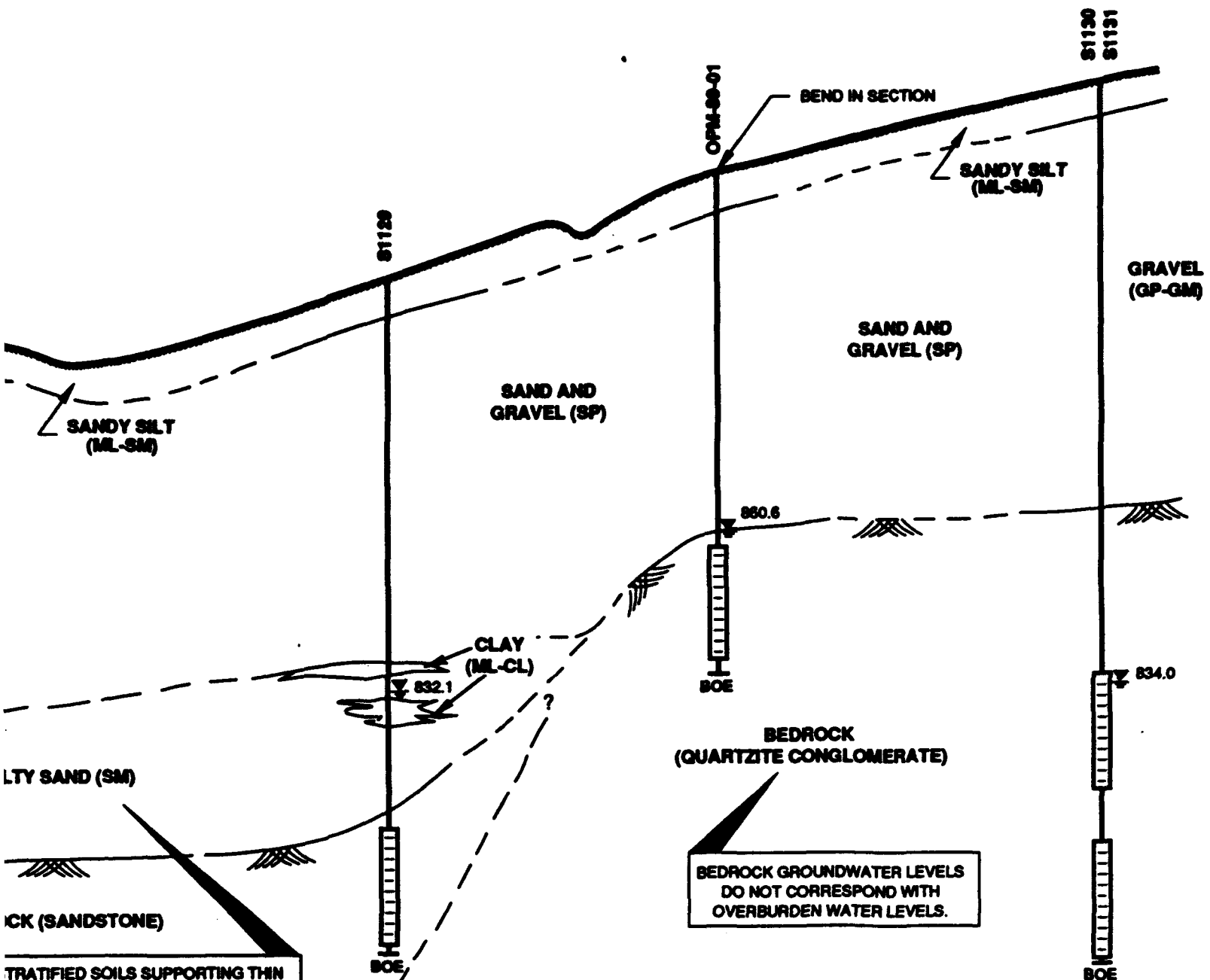
**LEGEND**



- WELL DESIGNATION
- GROUND SURFACE
- SOILS DESCRIPTION AND USCS CLASSIFICATION
- WATER TABLE ELEVATION
- SCREENED INTERVAL
- BOTTOM OF EXPLORATION







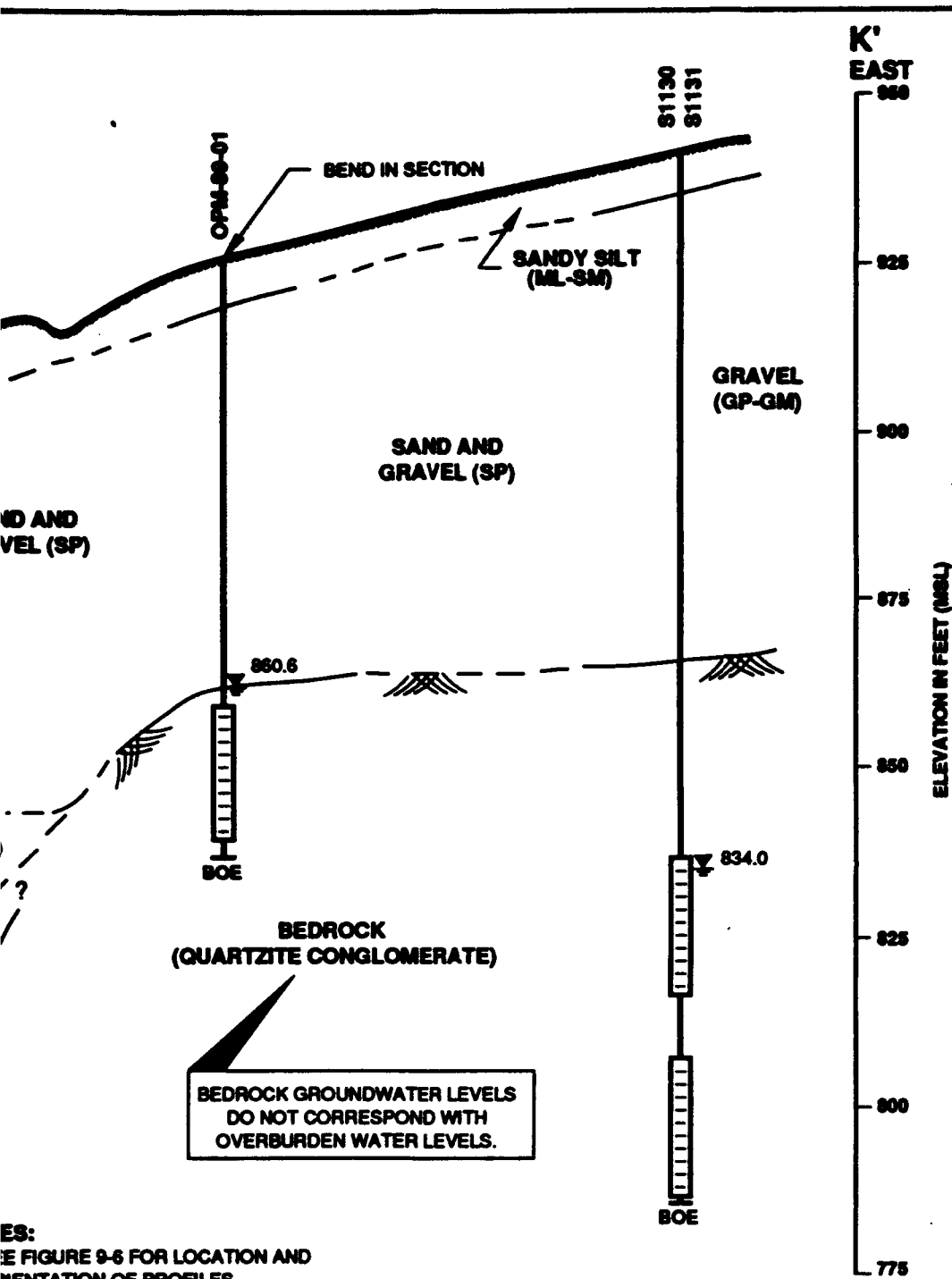
**NOTES:**

1. SEE FIGURE 9-6 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91.

**GEOLOGIC CROSS SECTION  
OLEUM PLANT, OLEUM PLANT POND AND BALLS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION**

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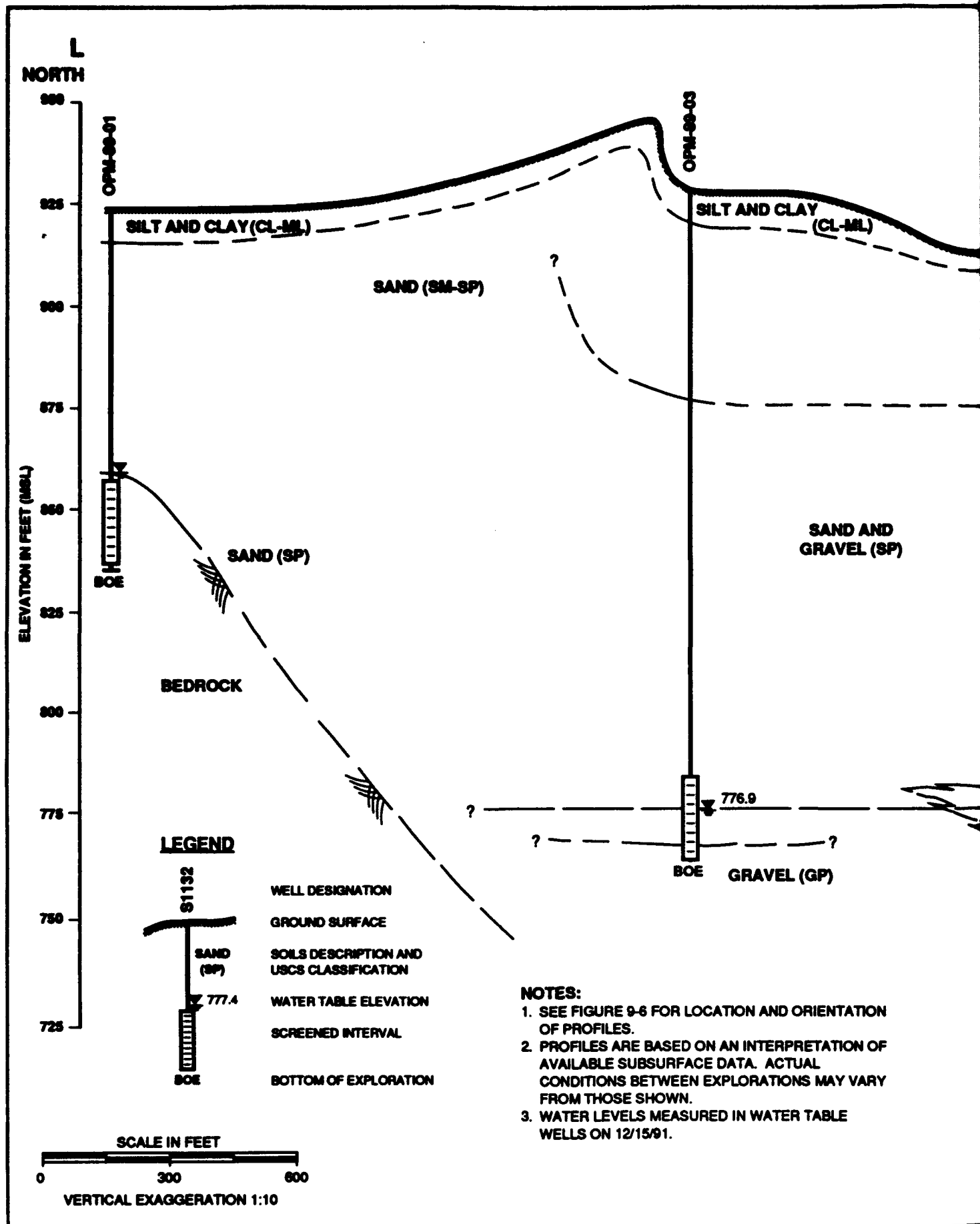


ES:  
 E FIGURE 9-6 FOR LOCATION AND  
 ENTATION OF PROFILES.  
 OFILES ARE BASED ON AN INTERPRETATION  
 F AVAILABLE SUBSURFACE DATA. ACTUAL  
 NDITIONS BETWEEN EXPLORATIONS MAY  
 Y FROM THOSE SHOWN.  
 ATER LEVELS MEASURED IN WATER TABLE  
 ELLS ON 12/15/91.

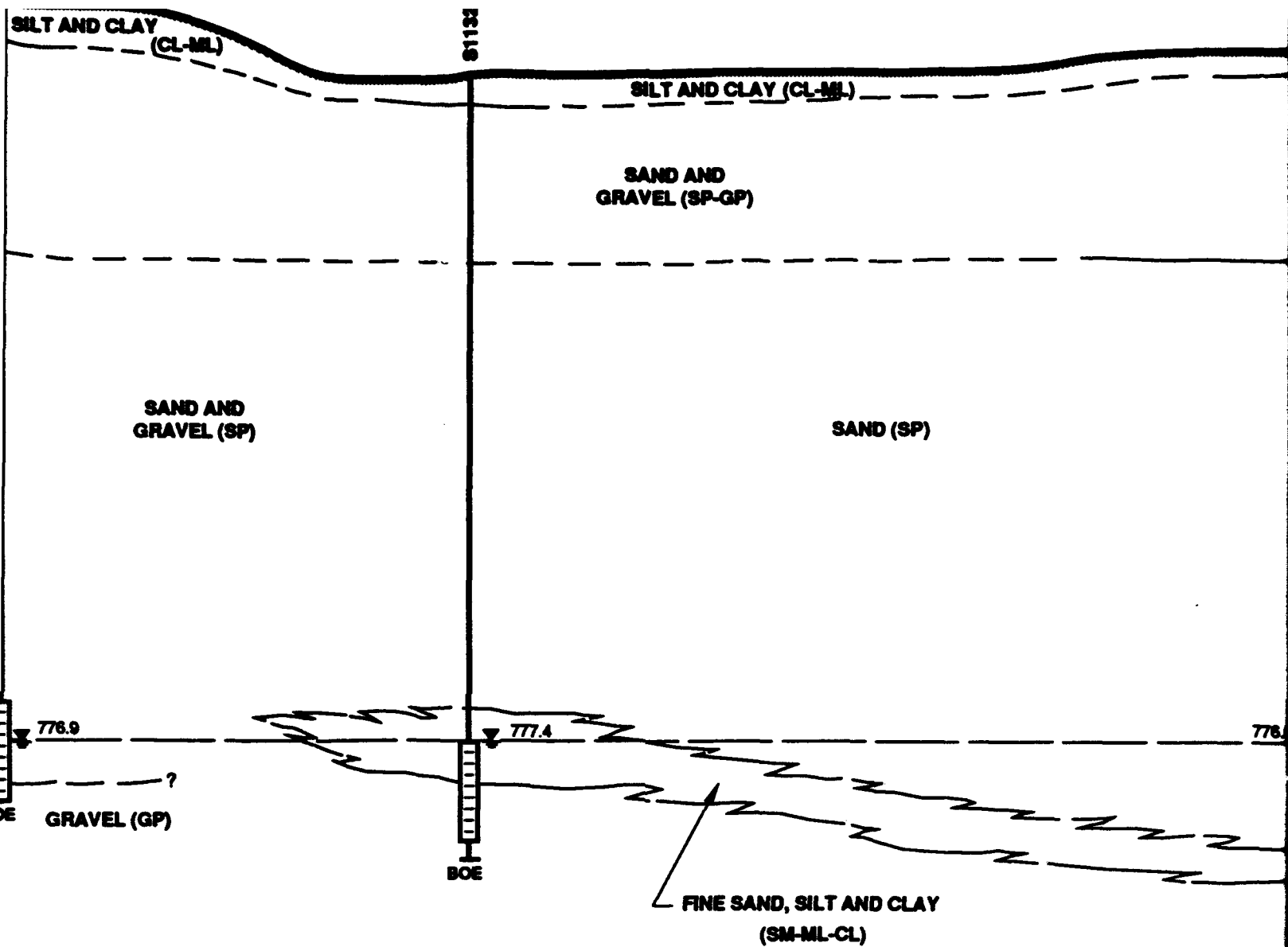
**FIGURE 9-7**  
**GEOLOGIC CROSS SECTION K-K'**  
**OLEUM PLANT, OLEUM PLANT POND AND BALLISTICS POND**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.









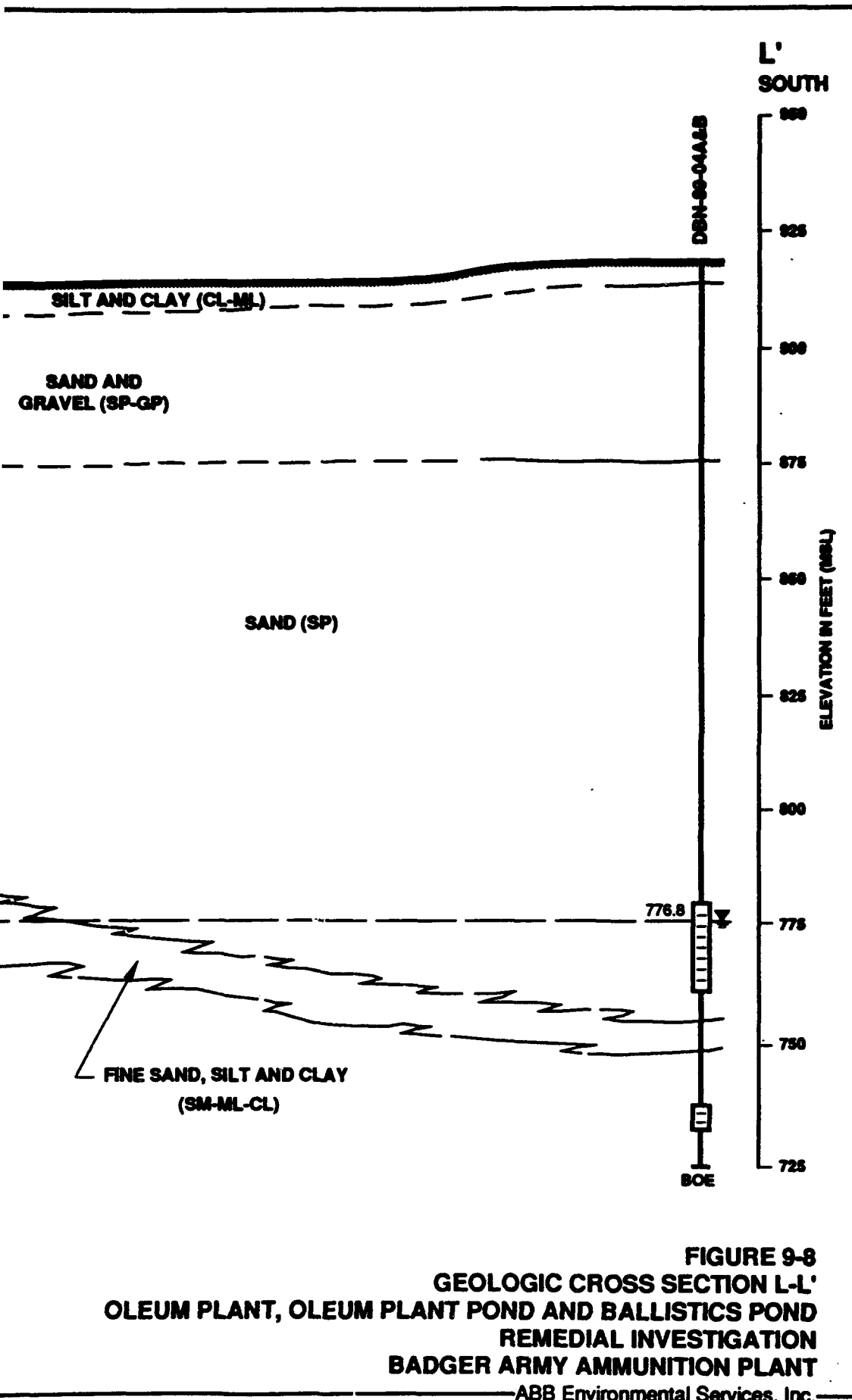
LOCATION AND ORIENTATION

ON AN INTERPRETATION OF  
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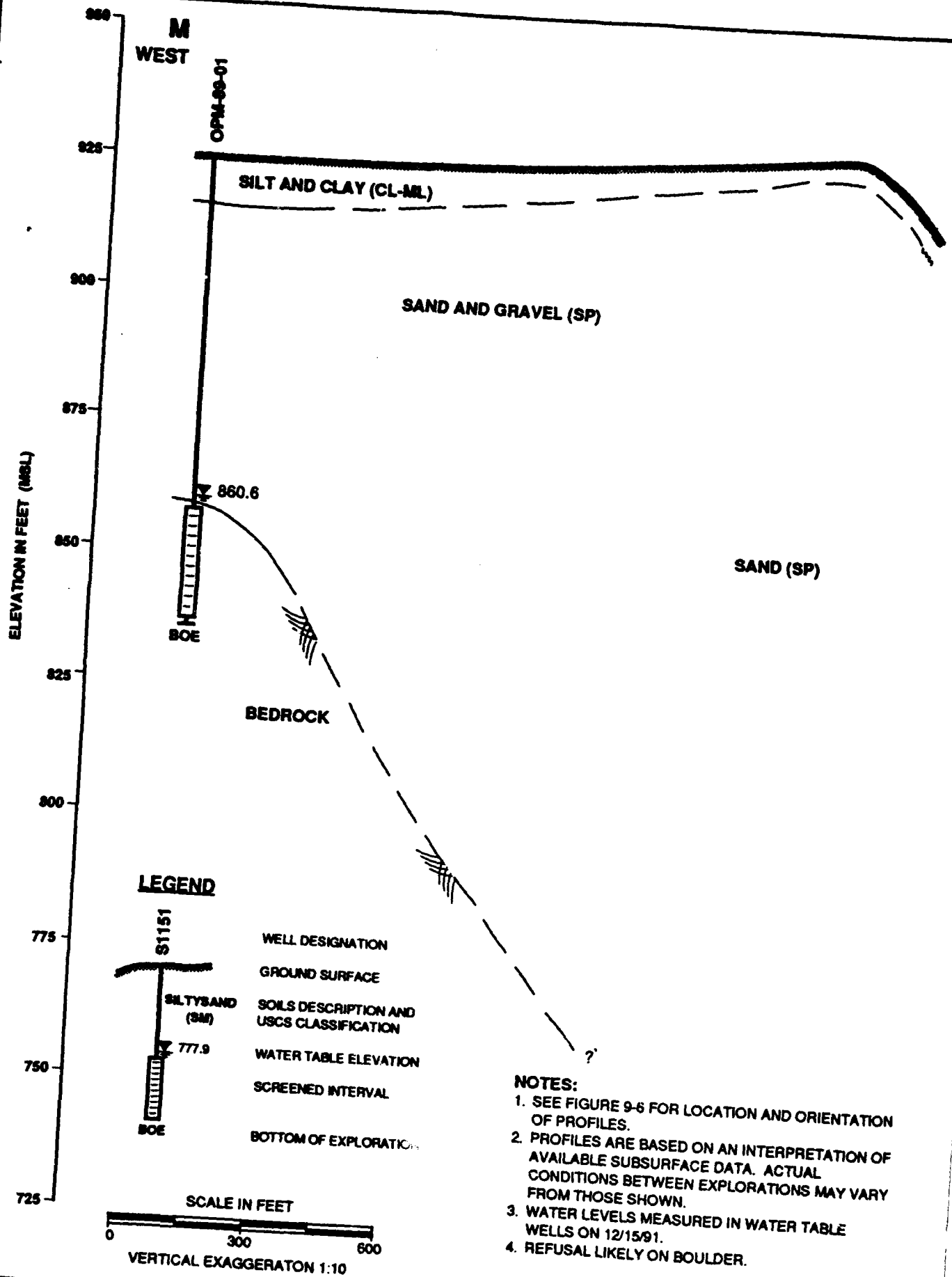
URED IN WATER TABLE

**GEOLOGIC CROSS S**  
**OLEUM PLANT, OLEUM PLANT POND AND BALL**  
**REMEDIAL INV**  
**BADGER ARMY AMMUNI**  
—ABB Environment







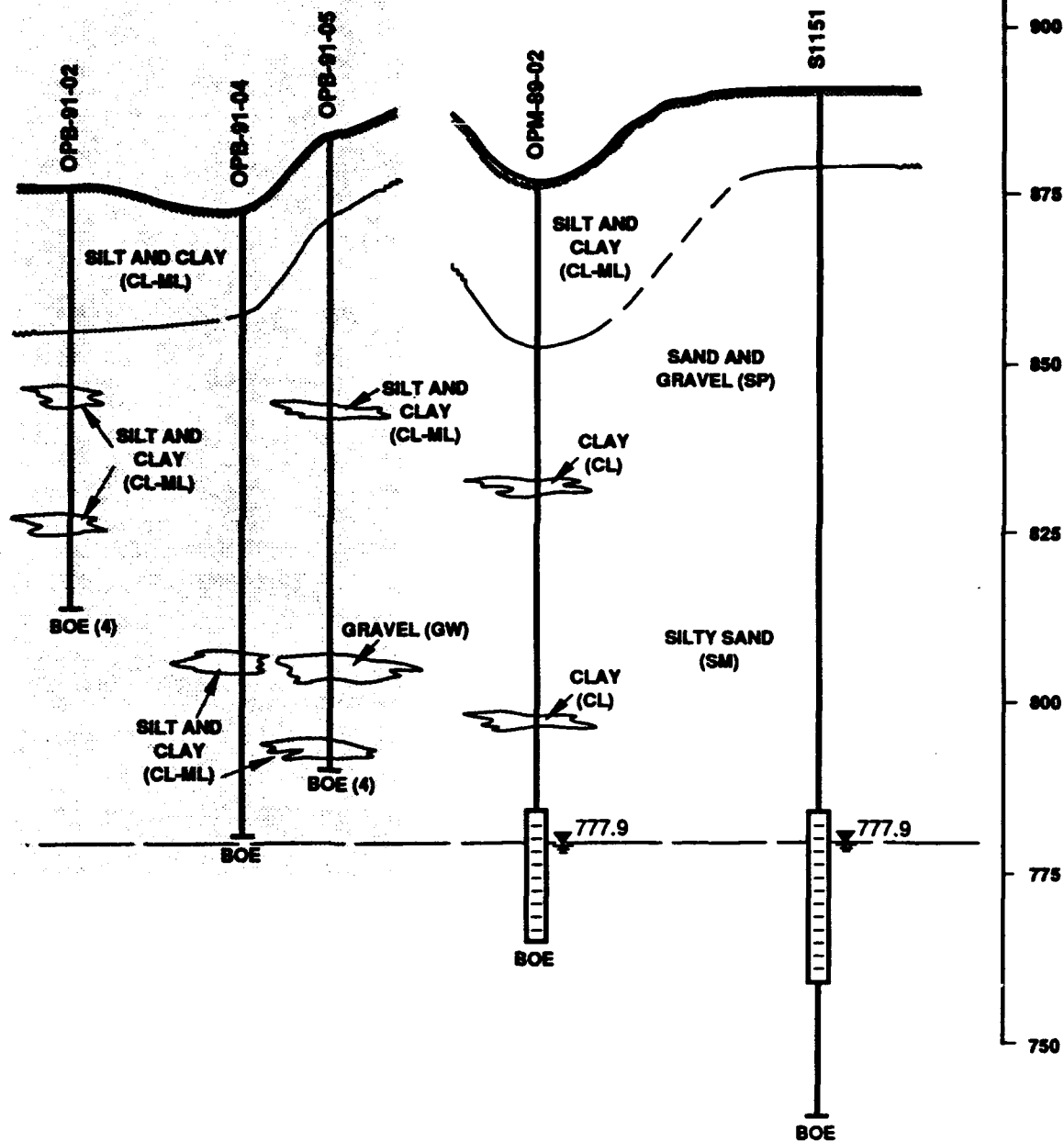




M'  
EAST

THESE BORINGS ARE  
LOCATED AT THE  
OLEUM PLANT POND  
AND ARE OFFSET 300  
TO 500 FEET NORTH.

SAND (SP)



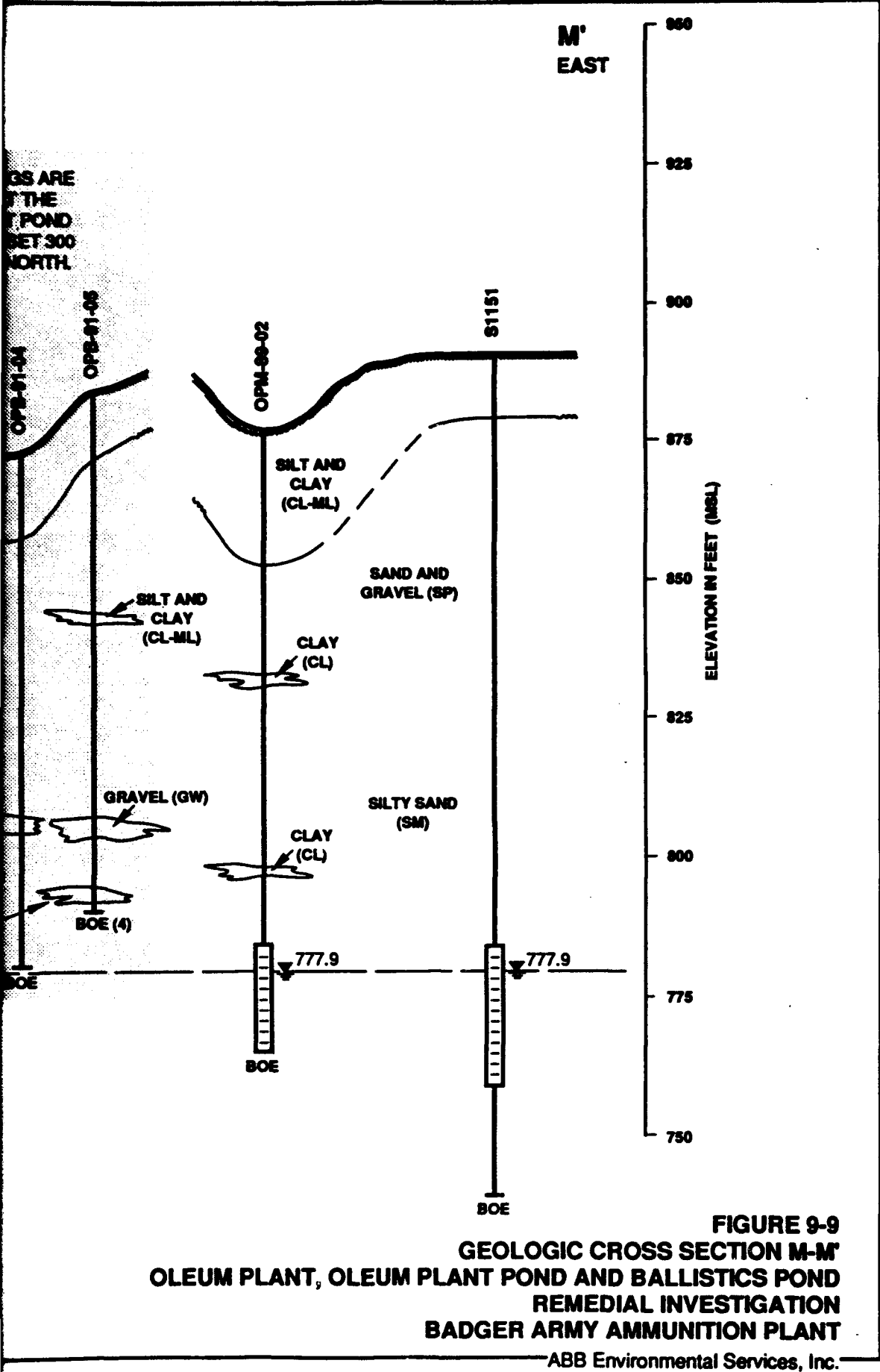
9-6 FOR LOCATION AND ORIENTATION  
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UBSURFACE DATA. ACTUAL  
BETWEEN EXPLORATIONS MAY VARY  
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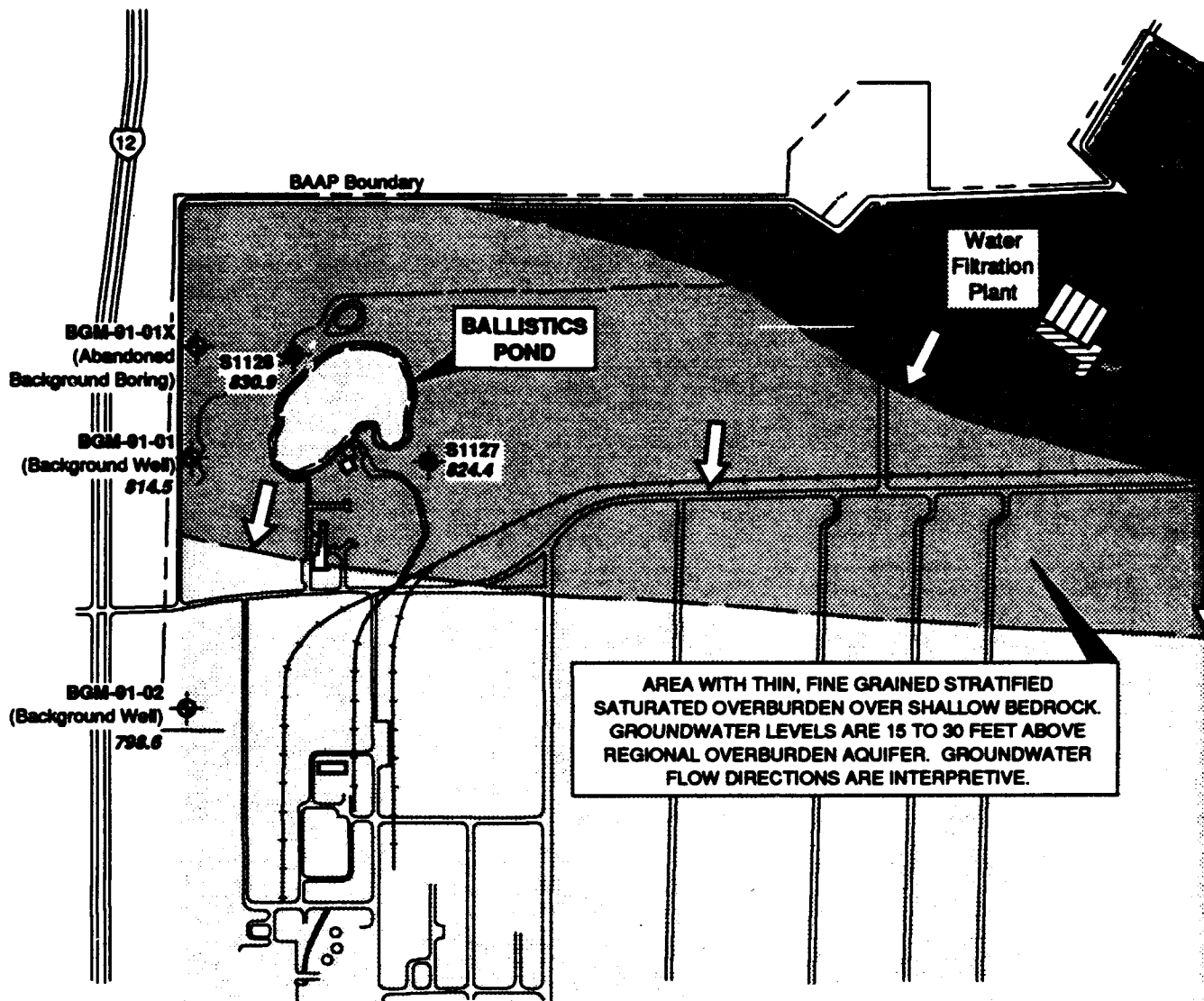
ABB Environment



GS ARE  
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POND  
SET 300  
NORTH







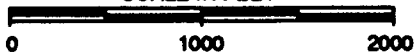
### LEGEND

- EXISTING MONITORING WELL
- NEW MONITORING WELL
- 798.6** WATER TABLE ELEVATION
- INTERPRETIVE GROUNDWATER FLOW DIRECTION

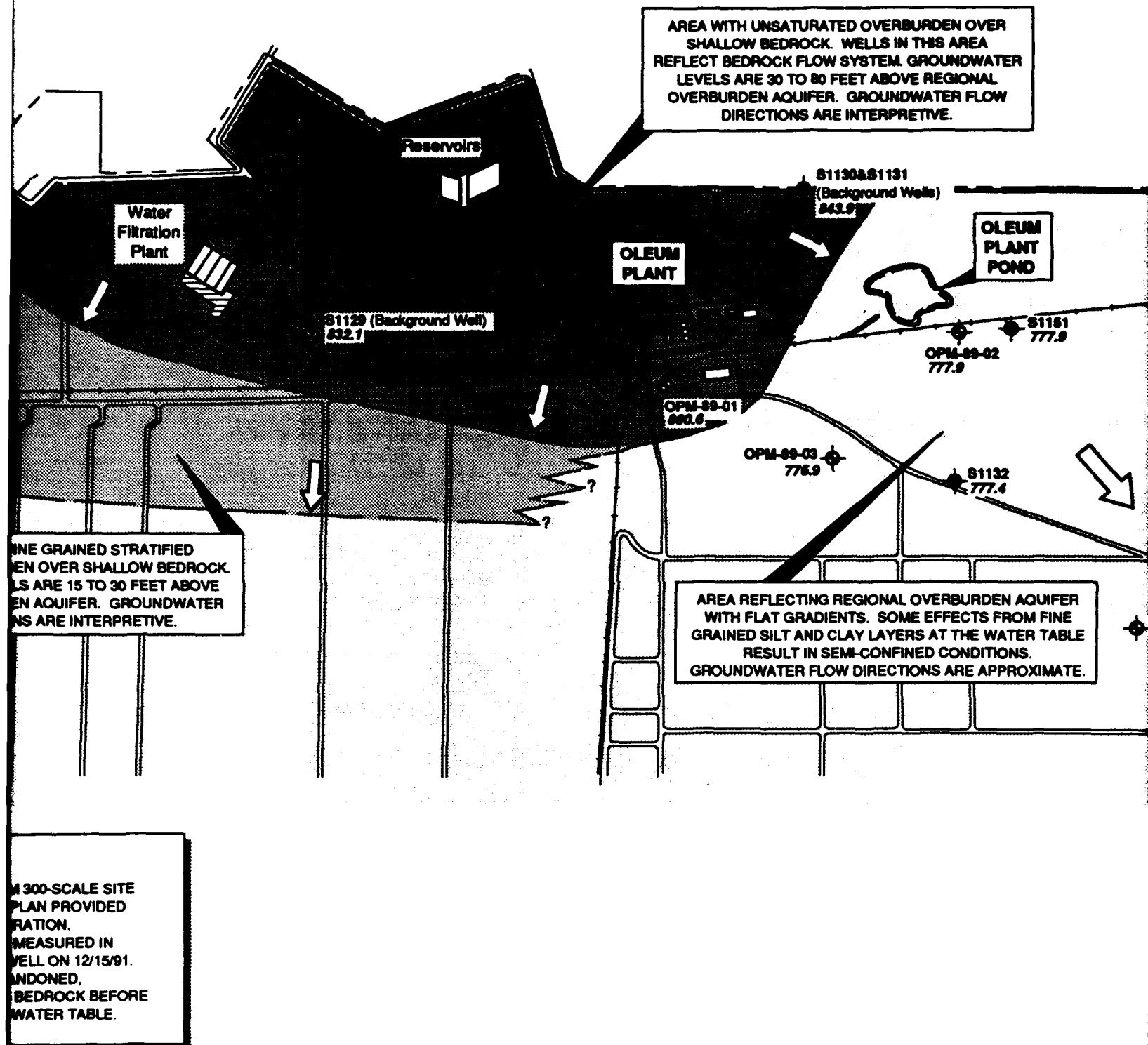
### NOTES:

1. BASE MAP FROM 300-SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. WATER LEVELS MEASURED IN WATER TABLE WELL ON 12/15/91.
3. BGM-91-01X ABANDONED, ENCOUNTERED BEDROCK BEFORE REACHING THE WATER TABLE.

SCALE IN FEET

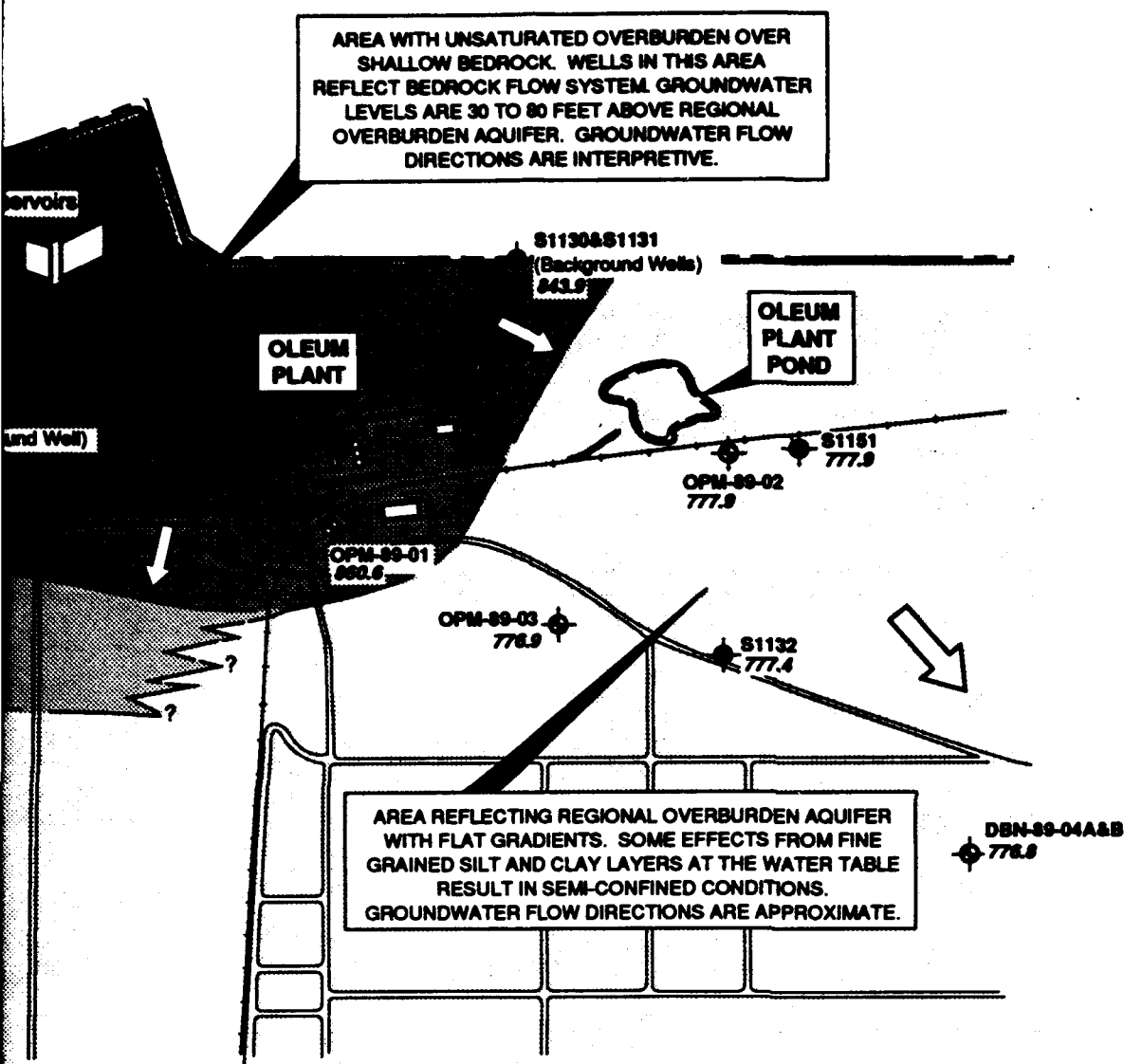






**FIG 1**  
**INTERPRETIVE GROUNDWATER FLOW DIRECTION**  
**OLEUM PLANT, OLEUM PLANT POND AND BALLISTIC REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**

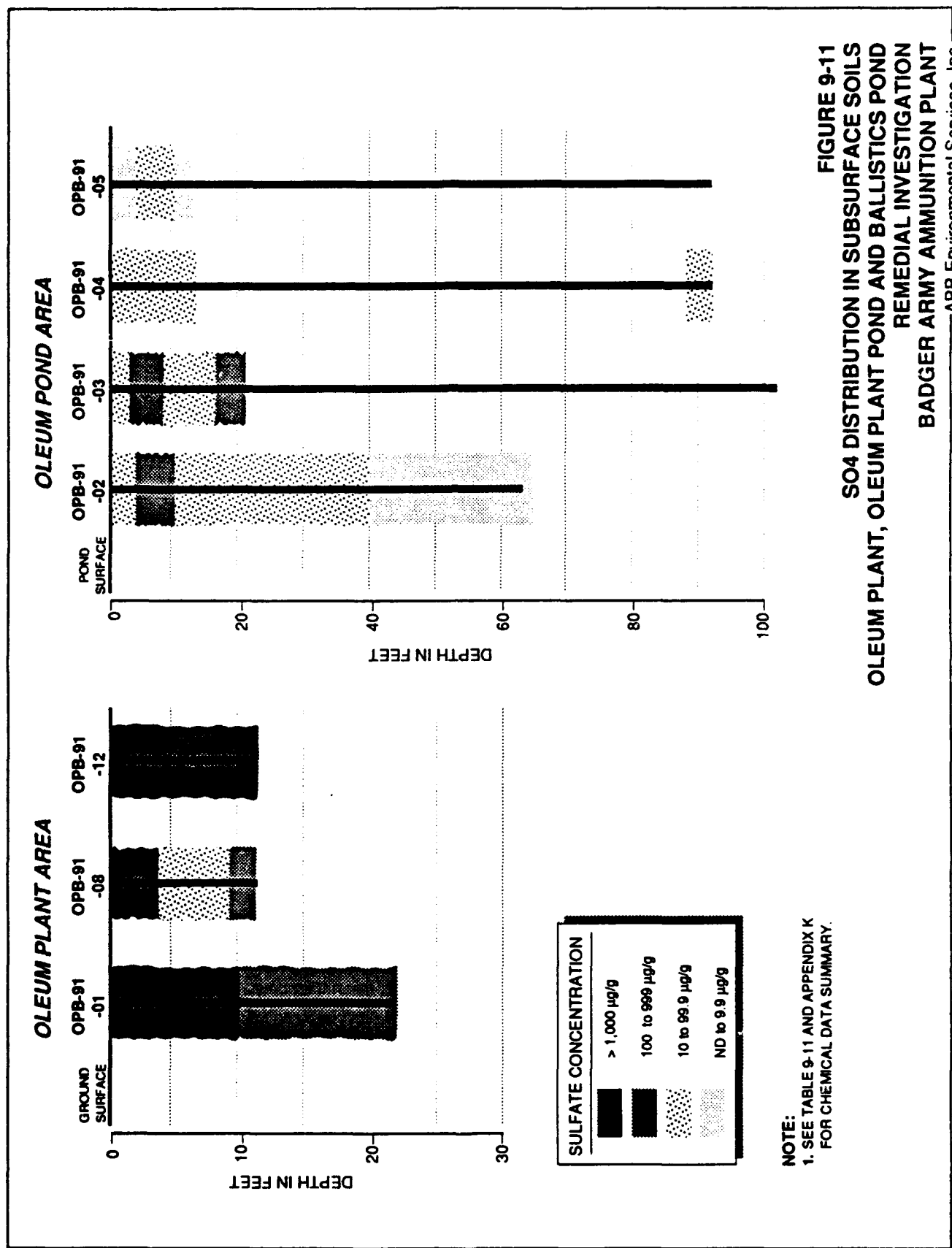




**FIGURE 9-10**

**INTERPRETIVE GROUNDWATER FLOW DIRECTIONS  
OLEUM PLANT, OLEUM PLANT POND AND BALLISTICS POND  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**







**TABLE 10-1**  
**HISTORY OF ACID AND FUEL OIL SPILLS -**  
**OLD ACID AREA/OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SPILL DATE	CAUSE	MATERIAL	AMOUNT	CONTROL
1970-72	Tank leakage	Acid	25 tons	Unknown
10/82	Tank leakage	Sulfuric acid	6.5 tons	Diked, neutralized
5/91	Pipeline Rupture	No. 2 Fuel Oil	5,000 gallons	Groundwater, pumping
?	Tank leakage/ Overflow	Fuel Oil	unknown	None

Source: Tsai et al., 1988.



**TABLE 10-2**  
**SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -**  
**OLD ACID AREA/OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

SITES	PROGRAM ELEMENTS			
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING
Old Acid Area	--	--	3 new wells; 8 samples from 3 new and 1 existing wells	3 deep borings, 5 samples from each; 10 shallow borings, 2 samples from each
Old Fuel Oil Tank	--	--	1 new well; 2 samples from the new well	2 borings, 5 samples from each

**Notes:**

\* Includes 2 rounds of groundwater sampling



**TABLE 10-3**  
**SUMMARY OF BORINGS COMPLETED -**  
**OLD ACID AREA/OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

<b>BORING NUMBER</b>	<b>DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)</b>	<b>TOTAL NUMBER OF SPLIT-SPOON SAMPLES</b>	<b>NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS</b>	<b>PURPOSE</b>
<u>Old Acid Area</u> OAB-91-01	92	14	5	This deep boring was drilled directly downgradient of the nitric acid and sulfuric acid concentration facilities to determine whether residual contamination exists in the soil directly downgradient of these potential source areas.
OAB-91-02	92	13	5	This boring was drilled downgradient of the Old Acid Area storage tank to provide chemical data to characterize the type and vertical distribution of residual subsurface soil contamination.
OAB-91-03	91	13	5	This boring was drilled downgradient, adjacent to waste acid neutralization facility to characterize the vertical distribution of subsurface soil contamination near the facility.
OAB-91-04 <sup>1</sup>	3.0	NA	2	These shallow hand-auger borings and samples were made in and around the Old Acid Plant Production Facilities to evaluate the areal extent of shallow soil contamination.
OAB-91-05 <sup>1</sup>	2.0	NA	2	
OAB-91-06 <sup>1</sup>	2.0	NA	2	
OAB-91-07 <sup>1</sup>	2.0	NA	2	
OAB-91-08 <sup>1</sup>	3.0	NA	2	
OAB-91-09 <sup>1</sup>	2.5	NA	2	
OAB-91-10 <sup>1</sup>	2.5	NA	2	
OAB-91-11 <sup>1</sup>	3.0	NA	2	
OAB-91-12 <sup>1</sup>	3.0	NA	2	
OAB-91-13 <sup>1</sup>	2.5	NA	2	This boring and samples provide background shallow soils data for the Old Acid Area.



continued

TABLE 10-3  
SUMMARY OF BORINGS COMPLETED -  
OLD ACID AREA/OLD FUEL OIL TANK AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

BORING NUMBER	DEPTH OF SOIL BORING FROM GROUND SURFACE (ft)	TOTAL NUMBER OF SPLIT-SPOON SAMPLES	NUMBER OF SUBSURFACE SOIL SAMPLES FOR CHEMICAL ANALYSIS	PURPOSE
Oil Fuel Oil Tank				
FTB-91-01	92.0	13	5	This boring was drilled at the location of a former fuel oil storage tank to characterize the type and vertical distribution of residual contamination.
FTB-91-02	89.0	13	5	This boring was drilled downgradient of the former fuel oil storage tank and upgradient of the most recent fuel oil spill as reported by BAAP in May 1991.

Notes:

<sup>1</sup> OPB-91-04 through OAB-91-13 were collected using hand bucket auger.

ft = feet

NA = not applicable



TABLE 10-4  
SUMMARY OF MONITORING WELLS INSTALLED -  
OLD ACID AREA/OLD FUEL OIL TANK AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
<u>Old Acid Area</u>						
OAM-89-01	Hollow-stem augers	102	771.7	20	Downgradient of the former acid storage tanks.	To provide water quality definition downgradient of the old acid production facility and the acid storage tanks that reportedly leaked.
OAM-89-02	Hollow-stem augers	102	772.4	20	Downgradient of the former waste acid treatment facilities.	To provide water quality data at the water table approximately 600 feet downgradient of the waste acid neutralization facility.
OAM-91-01	Dual-wall driven casing	100.0	779.6	10	Downgradient of the Old Acid Plant.	To provide groundwater flow data and assess groundwater quality downgradient of the Old Acid Plant.
<u>Old Fuel Oil Tank</u>						
FTM-89-01	Hollow-stem augers	103	772.9	20	Downgradient of the fuel oil spill site.	To provide water quality data at the water table approximately 150 feet downgradient of the former fuel oil tank.

Notes:

ft = feet  
MSL = Mean Sea Level



**TABLE 10-5**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**OLD ACID AREA/OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>SITES</b>	<b>NEW WELLS</b>	<b>EXISTING WELLS</b>
Old Acid Area	OAM-89-01 OAM-89-02 OAM-91-01	S1126
Subtotal	3	1
Old Fuel Oil Tank	FTM-89-01	
Subtotal	1	0
<b>TOTAL WELLS</b>	<b>4</b>	<b>1</b>



TABLE 10-6  
CHEMICAL ANALYSES PERFORMED ON SUBSURFACE SOIL SAMPLES -  
OLD ACID AREA/OLD FUEL OIL TANK

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	METALS												INORGANICS				OTHER				ORGANICS			
	METALS						TCLP METALS						ANIONS				TOC	pH	TPHC	VOC	BN/A	MG	NAM	DNT
	PP	TAL	CD	CR	HG	FE	NI	PB	CD	CR	HG	PB	NIT	SO4										
OLD ACID AREA																								
OAB-91-01	--	--	5	5	--	--	5	5	--	--	--	--	5	5	5	--	5	--	--	--	--	--	--	--
OAB-91-02	--	--	5	5	--	--	5	5	--	--	--	--	5	5	5	--	5	--	--	--	--	--	--	--
OAB-91-03	--	--	5	5	--	--	5	5	--	--	--	--	5	5	5	--	5	--	--	--	--	--	--	--
OAB-91-04	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-05	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-06	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-07	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-08	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-09	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-10	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-11	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-12	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OAB-91-13	--	--	--	--	--	--	--	--	--	--	--	--	2	2	2	--	--	--	--	--	--	--	--	--
OLD FUEL OIL TANK																								
FTB-91-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5	5	--	--	--	--	--
FTB-91-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	5	5	--	--	--	--	--
TOTALS	0	0	15	15	0	0	15	15	0	0	0	0	35	35	0	15	10	25	10	0	0	0	0	0

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)  
VOC = volatile organic compounds by GC/MS  
GC/MS = Gas Chromatography/Mass Spectrometry  
BN/A = base-neutral and acid-extractable organics by GC/MS  
NAM = nitroamines by GC  
DNT = 2,4- and 2,6-dinitrotoluene by HPLC  
HPLC = High Performance Liquid Chromatography

USA012 wk1



TABLE 10-7  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
OLD ACID AREA/OLD FUEL OIL TANK AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS													ORGANICS					TPH			
	METALS						ANIONS			OTHER				VOC								
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	BIN/A		NG	NAM	DNT
OLD ACID AREA																						
OAM-89-01	-	-	1	1	1	1	-	8	1	8	8	8	8	8	8	8	-	8	-	-	-	
OAM-89-02	-	-	1	1	1	1	-	8	1	8	8	8	8	8	8	8	-	8	-	-	-	
S1126	-	-	1	1	1	1	-	8	1	8	8	8	8	8	8	8	-	8	-	-	-	
OAM-81-01	-	-	1	1	1	1	-	8	1	8	8	8	8	8	8	8	-	8	-	-	-	
OLD FUEL OIL TANK																						
FTM-89-01	-	-	-	-	-	-	-	-	-	8	8	8	8	8	8	8	-	8	8	-	8	

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)

TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BN/A = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography

B = Analyzed in Both Rounds (One and Two).

1 = Analyzed in Round One Only.

USA017.WK1



**TABLE 10-8**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**OLD ACID AREA/OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (cm/sec)</b>	<b>GEOLOGIC CONDITIONS</b>
OAM-89-01	3.1	$2 \times 10^{-2}$	Medium to fine sand (SP)
FTM-89-01	3.6	$3 \times 10^{-2}$	Medium to fine sand (SP)

**Notes:**

Hydraulic Conductivity Tests completed during March and November, 1989, and November and December 1991.

Field data and calculations are presented in Appendix I.

Values for hydraulic conductivities represent an averaged value of multiple tests performed on each well.

Water level recovery at these wells impacted by inertial effects, resulting in water level recovery above static water levels. Hydraulic conductivity measurements may be greater than the calculated values at these wells.

cm/sec = centimeters per second



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK AREA  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	FTB-91-01	FTB-91-01	FTB-91-01	FTB-91-01	FTB-91-01	FTB-91-01	FTB-91-02	FTB-91-02	FTB-91-02	FTB-91-02	FTB-91-02
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91	10/22/91
DEPTH:	2.000	7.000	12.000	17.000	92.000	2.000	6.000	11.000	21.000	89.000	
VOCs	ACET	-	-	-	-	-	-	-	-	-	-
	CH2CL2	-	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	1.070	-	-	-	-	-	-	-	-	-
	ANAPNE	0.077	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-	-
	BAANTR	0.080	0.118	-	-	-	1.230	1.800	-	-	1.380
	BGHPY	0.396	-	-	-	-	-	-	-	-	-
	CHIRY	0.076	0.113	-	-	-	-	-	-	-	-
	DNBP	-	2.100	-	-	-	-	-	-	-	-
	FANT	0.037	-	-	-	-	-	-	-	-	-
	FLRENE	0.160	-	-	-	-	-	-	-	-	-
	PHANTR	0.194	-	-	-	-	-	-	-	-	-
Metals	CR	-	-	-	-	-	-	-	-	-	-
	NI	-	-	-	-	-	-	-	-	-	-
	PB	-	-	-	-	-	-	-	-	-	-
Asions	NIT	-	-	-	-	-	-	-	-	-	-
	SO4	-	-	-	-	-	-	-	-	-	-
Indicator	pH(1)	-	-	-	-	-	-	-	-	-	-
parameter	TPHC	430.000	1180.000	21.800	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OAB-91-01	OAB-91-01	OAB-91-01	OAB-91-01	OAB-91-01	OAB-91-01	OAB-91-01	OAB-91-02	OAB-91-02	OAB-91-02	OAB-91-02	OAB-91-02	OAB-91-02
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91	10/09/91
DEPTH:	2.000	6.000	11.000	21.000	91.000	2.000	7.000	12.000	22.000	92.000			
VOCS	ACET	-	0.004 S	0.002 S	0.004 S	-	0.008 S	-	-	-	-	-	-
	CH2CL2	-	-	-	-	-	-	-	-	-	-	-	-
	MEK	0.006 S	0.008 S	0.007 S	0.006 S	0.006 S	0.008 S	0.006 S	0.002 S	0.002 S	0.002 S	0.002 S	0.002 S
SVOCs	2MNAP												
	ANAPNE												
	B2EHP												
	BAANTR												
	BGHPY												
	CHRY												
	DNBP												
	FANT												
	FLRENE												
	PHANTR												
Metals	CR	14.400	17.600	3.880	3.810	3.820	16.400	13.500	2.400	1.280	6.880		
	NI	56.900	17.300	4.810	3.190	-	20.100	11.600	8.360	4.600	3.110		
	PB	1500.000	64.000	3.240	4.630	0.726	4.870	240.000	3.030	2.880	15.000		
Antons	NIT	1.380	8.280	2.780	1.930	1.240	-	2.610	1.520	1.720	2.300		
	SO4	3900.000	240.000	53.200	32.100	-	31.300	2500.000	350.000	56.800	27.400		
Indicator	pH(1)	7.880	9.280	9.020	9.140	10.400	9.060	8.440	8.440	8.930	11.100		
parameter	TPHC												

Notes and flagging codes are presented at the end of this table.



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OAB-91-03	OAB-91-03	OAB-91-03	OAB-91-03	OAB-91-03	OAB-91-03	OAB-91-04	OAB-91-04	OAB-91-05	OAB-91-05	OAB-91-06
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/16/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91
DEPTH:	2.000	6.000	11.000	21.000	91.000	2.000	2.000	2.000	2.000	2.000	0.000
VOCs	ACET	-	-	-	-	-	-	-	-	-	-
	CH2CL2	-	-	-	-	-	-	-	-	-	-
	MEK	-	-	-	-	-	-	-	-	-	-
SVOCs	2MNAP	-	-	-	-	-	-	-	-	-	-
	ANAPNE	-	-	-	-	-	-	-	-	-	-
	B2EHP	-	-	-	-	-	-	-	-	-	-
	BAANTR	-	-	-	-	-	-	-	-	-	-
	BGRIPY	-	-	-	-	-	-	-	-	-	-
	CHRY	-	-	-	-	-	-	-	-	-	-
	DNEP	-	-	-	-	-	-	-	-	-	-
	FANT	-	-	-	-	-	-	-	-	-	-
	FLRENE	-	-	-	-	-	-	-	-	-	-
	PHANTR	-	-	-	-	-	-	-	-	-	-
Metals	CR	20.500	10.400	13.300	4.580	2.170	-	-	-	-	-
	NI	17.300	7.840	14.800	2.910	-	-	-	-	-	-
	PB	11.000	3.920	8.600	2.700	0.845	-	-	-	-	-
Anions	NTT	1.740	2.210	1.980	2.220	3.040	1.450	1.180	1.470	1.450	-
	SO4	130.000	36.000	44.800	-	-	20000.000	23000.000	18000.000	16000.000	56.800
Indicator parameter	pH(1)	8.470	5.940	6.550	8.950	9.610	-	-	-	-	-
	TPHC	-	-	-	-	-	-	-	-	-	-

Notes and flagging codes are presented at the end of this table.



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OAB-91-06	OAB-91-07	OAB-91-07	OAB-91-08	OAB-91-08	OAB-91-09	OAB-91-09	OAB-91-10	OAB-91-10	OAB-91-11
Sample Type:	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91
DEPTH:	1.500	1.500	1.500	1.000	2.000	0.000	2.000	0.000	2.000	0.000
VOCs	ACET									
	CH2CL2									
	MEK									
SVOCs	2MNAP									
	ANAPNE									
	B2EHP									
	BAAHTR									
	BGHPY									
	CHRY									
	DNBP									
	FANT									
	FLRENE									
	PHANTR									
Metals	CR									
	NI									
	PB									
Anions	NIT	1.090	1.110	-	-	-	1.160	-	1.790	-
	SO4	8200.000	5.780	170.000	36.200	-	-	-	-	-
Indicator parameter	pH(1)									
	TPHC									

Notes and flagging codes are presented at the end of this table.



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK  
REMEDIATION INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OAB-91-11	OAB-91-12	OAB-91-12	OAB-91-13	OAB-91-13
Sample Type:	BORE	BORE	BORE	BORE	BORE
UNITS:	UGG	UGG	UGG	UGG	UGG
DATE SAMPLED:	10/03/91	10/03/91	10/03/91	10/03/91	10/03/91
DEPTH:	2.000	0.000	2.000	0.000	2.000
VOCs	ACET CH2CL2 MEK				
SVOCs	2MNAP ANAPNE B2EHP BAANTR BGHPY CHRY DNBP FANT FLRENE PIANTR				
Metals	CR NI PB				
Anions	NIT SO4	1.480 6.100	1.690 12.400	5.610 -	- 16.600
Indicator parameter	PH(1) TPHC				

Notes and flagging codes are presented at the end of this table.



TABLE 10-9  
SUMMARY OF SUBSURFACE SOIL CHEMICAL DATA-  
OLD ACID AREA/ OLD FUEL OIL TANK  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCS	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits
		Appendix K contains complete analytical results

USATHIAMA chemical codes are defined in the RI Report Glossary



TABLE 10-10  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OLD ACID AREA/OLD FUEL OIL TANK AREA  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	OAM-89-01	OAM-89-02	OAM-91-01	FTM-89-01	S1126
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/11/91	12/11/91	12/11/91	12/11/91	04/15/92
ROUND:	ONE	ONE	ONE	ONE	TWO
	04/14/92	04/15/92	04/14/92	04/21/92	
	TWO	TWO	TWO	TWO	
VOCs					
ACET	7.6	-	-	-	-
CH2CL2	4.31	P	4.410 P	4.61 P	4.9 P
CHCL3	-	-	-	1.91	0.704 P
Metals					
CA	98000	95000	83000	94000	94000
CR	7.54	7.3	5.430	9.64	-
NA	-	-	-	-	32000
Anions					
NIT	5400	3600	1500	4000	5300
CL	43000	42000	8500	880000	44000
SO4	90300	76000	21000	360000	60000
Indicator					
ALK	328000	340000	246000	338000	370000
HARD	382000	368000	314000	886000	346000
TDS	487000	465000	353000	2060000	463000
pH(1)	7.3	7.2	7.4	7.1	7.3
Sp Cond.(2)	617	626	416	2370	602
					637

Notes and flagging codes are presented at the end of this table.



TABLE 10-10  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
OLD ACID AREA/ OLD FUEL OIL TANK  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

USATHIAMA chemical codes are defined in the RI Report Glossary



**TABLE 10-11**  
**COMPOUNDS OF POTENTIAL CONCERN**  
**OLD ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUNDS OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION	
	SURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )	SURFACE THROUGH SUBSURFACE SOIL <sup>2</sup> ( $\mu\text{g/g}$ )
ACET	--	0.008
CR	20.5	20.5
NI	56.9	56.9
NIT	5.61	8.28
PB	1,500	1,500
SO4	20,000	20,000

**Notes:**

-- = Not identified as a compound of potential concern

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm)

<sup>1</sup> Assessment of surface soil contamination (0 to 2 feet) was performed using samples from borings OAB-91-01 through OAB-91-13.

<sup>2</sup> Assessment of subsurface soil contamination (0 to 12 feet) was performed using samples from borings OAB-91-01 through OAB-91-13.



TABLE 10-12  
SUMMARY OF RISK ESTIMATES  
OLD ACID AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Current and Future Grounds Maintenance Worker	Soil Ingestion	ND	0.0003
	Inhalation of Particulates	<u>ND</u>	<u>ND</u>
	Total for Grounds Maintenance Worker	ND	0.0003
Future Residential	Soil Ingestion	ND	0.04
Future Construction Worker	Soil Ingestion	ND	0.01
	Inhalation of Particulates	<u><math>2 \times 10^{-6}</math></u>	<u>ND</u>
	Total for Construction Worker	$2 \times 10^{-6}$	0.01

**Notes:**

ND = not determined - no toxicity factors available for compounds of potential concern



**TABLE 10-13**  
**COMPOUNDS OF POTENTIAL CONCERN**  
**OLD FUEL OIL TANK AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUNDS OF POTENTIAL CONCERN	EXPOSURE POINT CONCENTRATION
	SUBSURFACE SOIL <sup>1</sup> ( $\mu\text{g/g}$ )
2MNAP	1.07
ANAPNE	0.077
B2EHP	1.8
BAANTR	0.122
BGHIPIY	0.396
CHRY	0.113
DNBP	2.1
FANT	0.037
FLRENE	0.16
PHANTR	0.194

**Notes:**

Exposure point concentration is the maximum detected concentration

$\mu\text{g/g}$  = micrograms per gram; equivalent to parts per million (ppm)

<sup>1</sup> Assessment of subsurface soil contamination (2 to 12 feet) was performed using samples from FTB-91-01 and FTB-91-02.



TABLE 10-14  
SUMMARY OF RISK ESTIMATES  
OLD FUEL OIL TANK AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

EXPOSURE SCENARIO	EXPOSURE ROUTE	CANCER RISK	HAZARD INDEX
Future Construction Worker	Soil Ingestion	$9 \times 10^{-9}$	0.001
	Inhalation of Particulates	$5 \times 10^{-11}$	ND
	Total for Construction Worker	$9 \times 10^{-9}$	0.001

**Notes:**

ND = not determined - no toxicity factors available for compounds of potential concern.



TABLE 10-15  
COMPARISON OF GROUNDWATER TO STANDARDS  
UNITS:  $\mu\text{g/l}$   
OLD ACID AREA/OLD FUEL OIL TANK AREA

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUNDS OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
CHCL3	5:10	3.22	0.704	-	-	6	0.6	-
CL	10:10	1,200,000	4,200	250,000(a)	-	250,000(c)	125,000(c)	-
CR	4:8	9.64	5.43	100	100	50(d)	5(d)	-
NA	4:8	32,000	10,000	20,000(b)	-	-	-	-
NIT	10:10	5,400	1,100	10,000	10,000	10,000	2,000	-
SO4	10:10	410,000	21,000	250,000(a)	-	250,000(c)	125,000(c)	-

Sources:

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards," Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of 10<sup>-6</sup>... H of 1 (see 4.5 for details).

Notes:

- (a) Secondary drinking water standard, suggested level.
- (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
- (c) Value for protection of human welfare (usually aesthetic concerns) rather than protection of public health.

$\mu\text{g/l}$  = micrograms per liter

SDWA = Safe Drinking Water Act

MCL = Maximum Contaminant Level

MCLG = Maximum Contaminant Level Goal

WI = Wisconsin

ES = Enforcement Standard

PAL = Preventive Action Limit

TT = Treatment technique requirement in effect

Copper action level = 1,300  $\mu\text{g/l}$

Lead action level = 15  $\mu\text{g/l}$

WI proposing change to ES = 100  $\mu\text{g/l}$  and PAL = 10  $\mu\text{g/l}$

(d)



**TABLE 10-16**  
**ECOLOGICAL CONTAMINANTS OF CONCERN<sup>A</sup>**  
**OLD ACID AREA**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

COMPOUND	FREQUENCY	EXPOSURE POINT CONCENTRATION <sup>B</sup>
<u>Surface Soil</u>		
NI	3:3	56.9
NIT	13:23	1.79
PB	3:3	1,500
SO4	16:23	18,000

**Notes:**

- <sup>A</sup>     Constituents selected based on criteria presented in Table Q-25 and discussed in Section 5.0.
- <sup>B</sup>     95th percentile or maximum; units in  $\mu\text{g/g}$ .
- <sup>C</sup>     Assessment of surface soil contamination (0 to 2 feet) was performed using samples from borings OAB-91-01 through OAB-91-13.



**TABLE 10-17**  
**SUMMARY OF RISK EVALUATION FOR TERRESTRIAL RECEPTORS**  
**OLD ACID AREA**

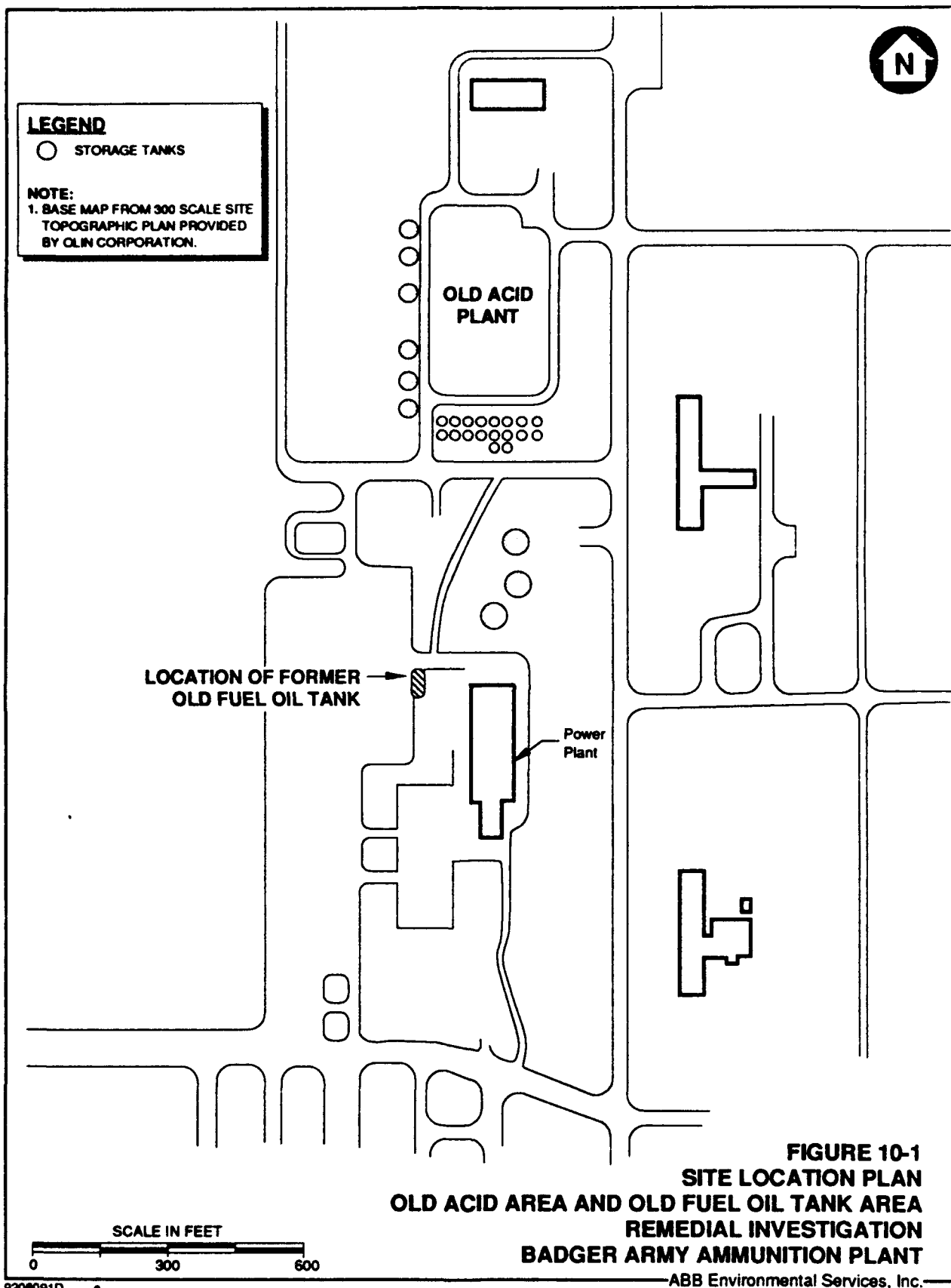
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

RECEPTOR	HAZARD INDICES <sup>a</sup>	
	ACUTE RISK <sup>b</sup>	CHRONIC RISK <sup>c</sup>
Short-tailed shrew	2.8E+03	5.7E+04
Eastern meadowlark	6.3E+01	1.8E+02
Garter snake	1.4E+02	2.8E+03
Red fox	3.1E+00	1.3E+00
Red-tailed hawk	9.8E+00	2.0E+00

**Notes:**

- <sup>a</sup> Sum of the individual Hazard Quotients for each surface soil contaminant of concern; each HQ calculated by dividing the estimated exposure dosage by the Reference Toxicity Value (RTV). Hazard Quotients are presented in Appendix R, Tables R-59 and R-60 for acute and chronic exposures, respectively.
- <sup>b</sup> Based on comparison to acute RTVs.
- <sup>c</sup> Based on comparison to chronic RTVs.





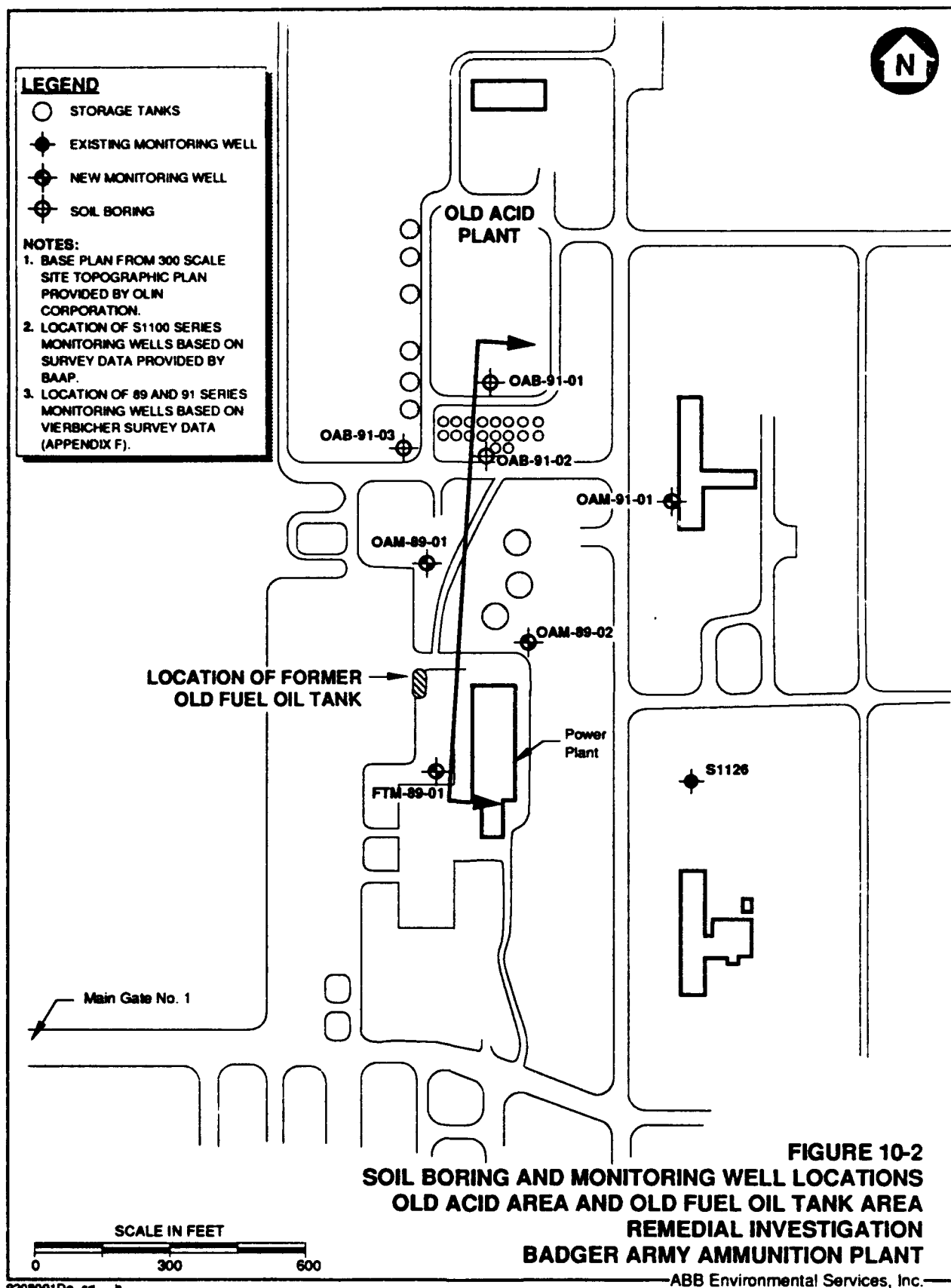


**LEGEND**

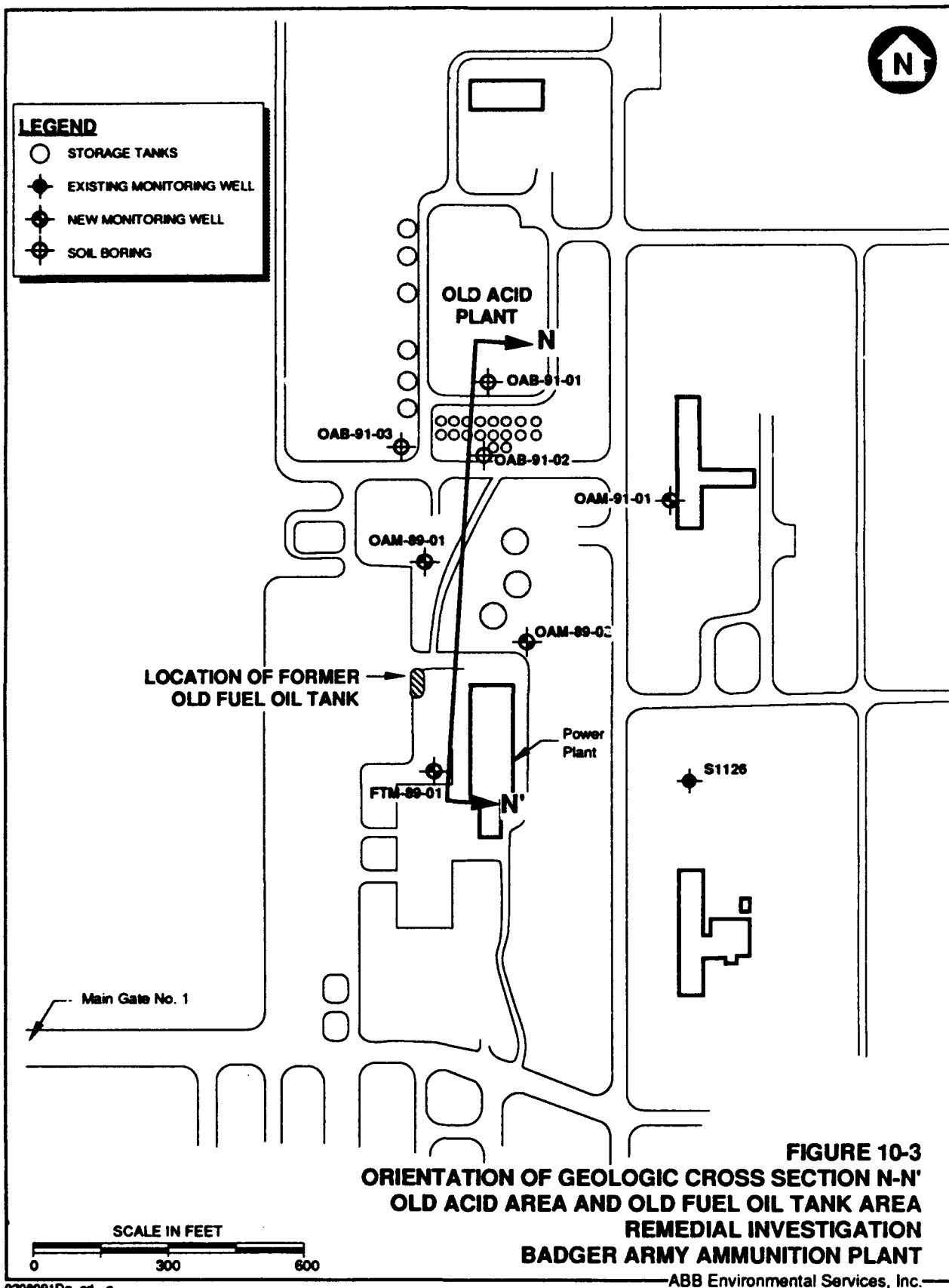
- STORAGE TANKS
- ◆ EXISTING MONITORING WELL
- ◆ NEW MONITORING WELL
- ⊕ SOIL BORING

**NOTES:**

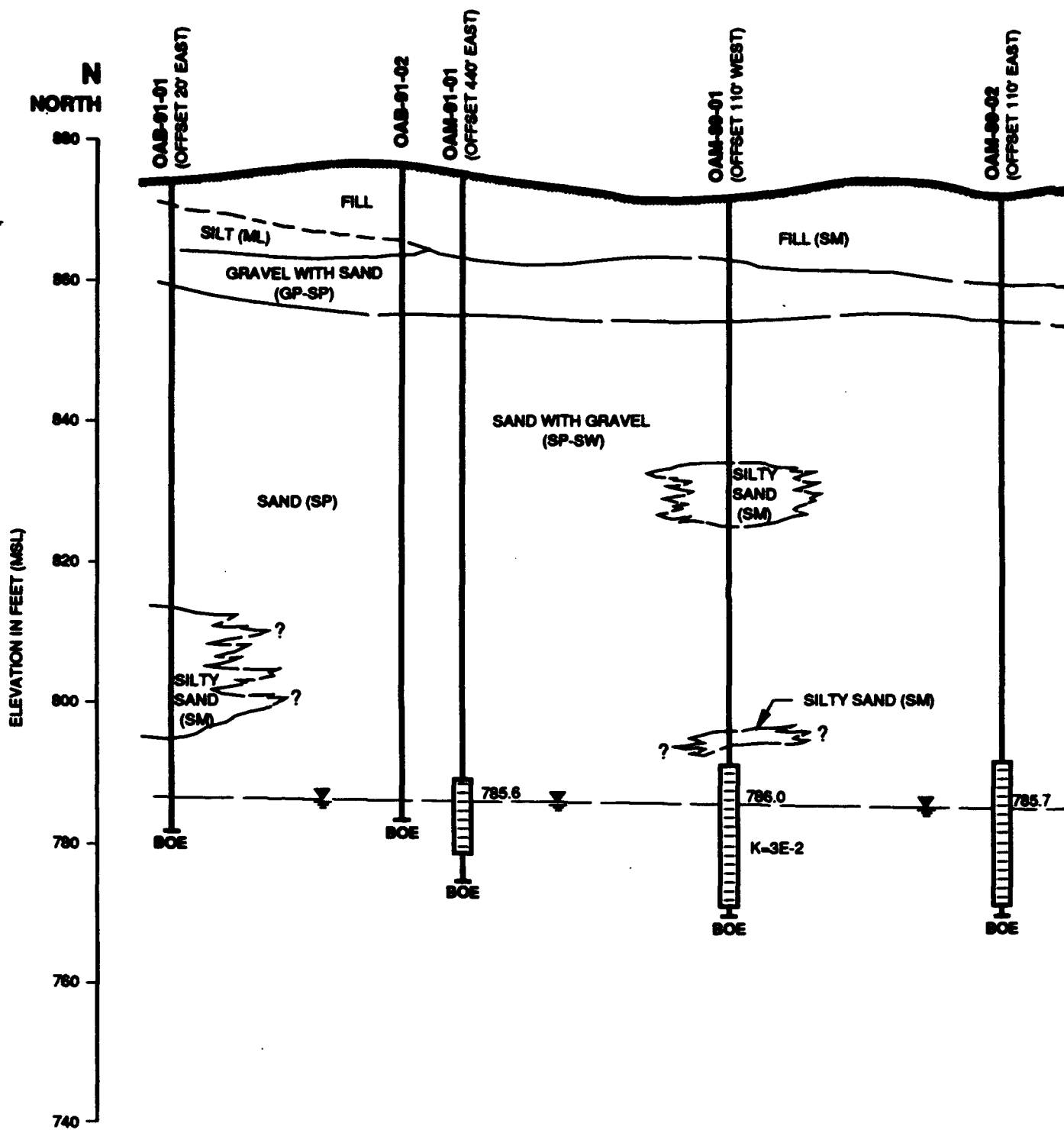
1. BASE PLAN FROM 300 SCALE SITE TOPOGRAPHIC PLAN PROVIDED BY OLIN CORPORATION.
2. LOCATION OF S1100 SERIES MONITORING WELLS BASED ON SURVEY DATA PROVIDED BY BAAP.
3. LOCATION OF 89 AND 91 SERIES MONITORING WELLS BASED ON VERBICHER SURVEY DATA (APPENDIX F).



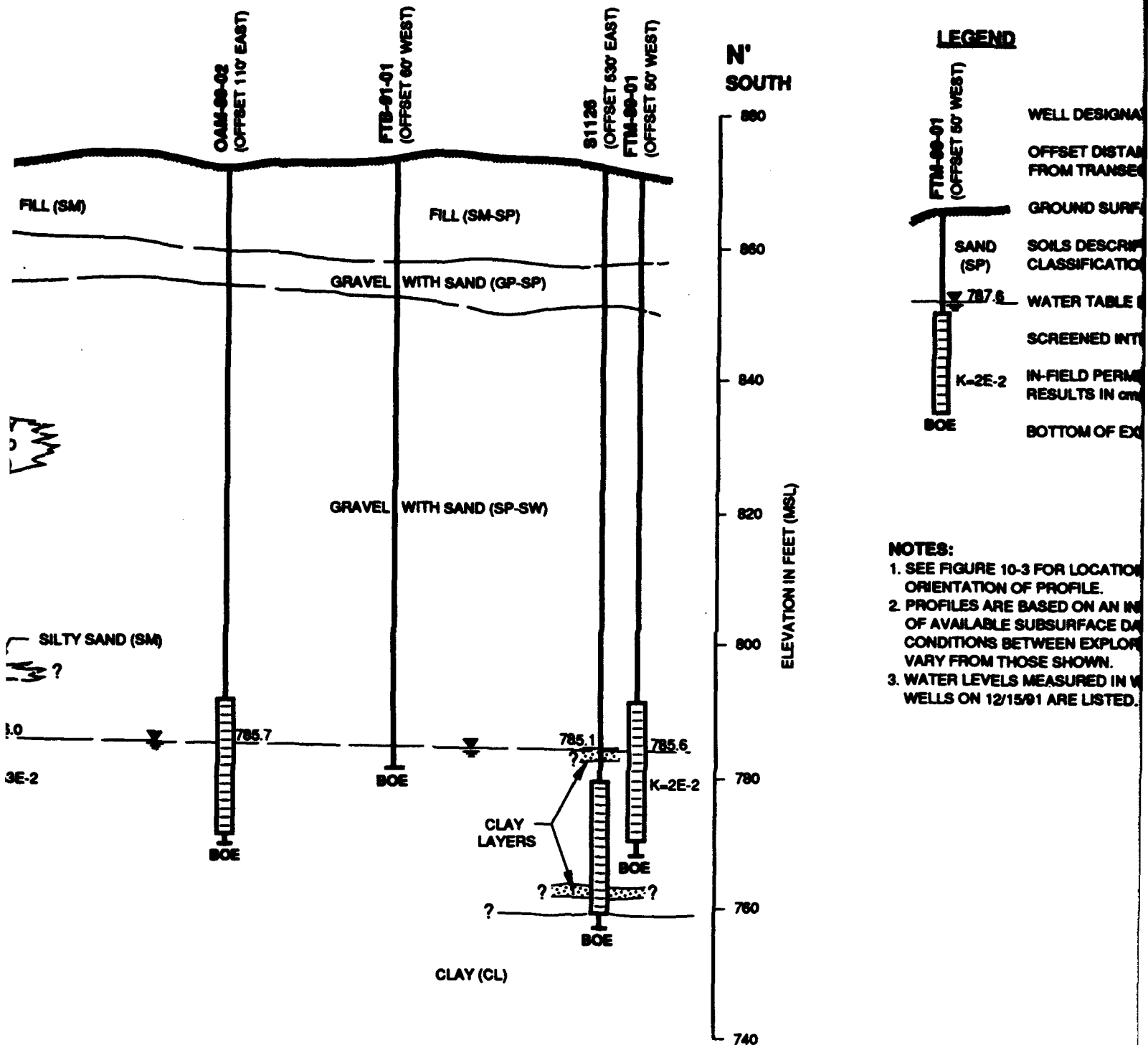






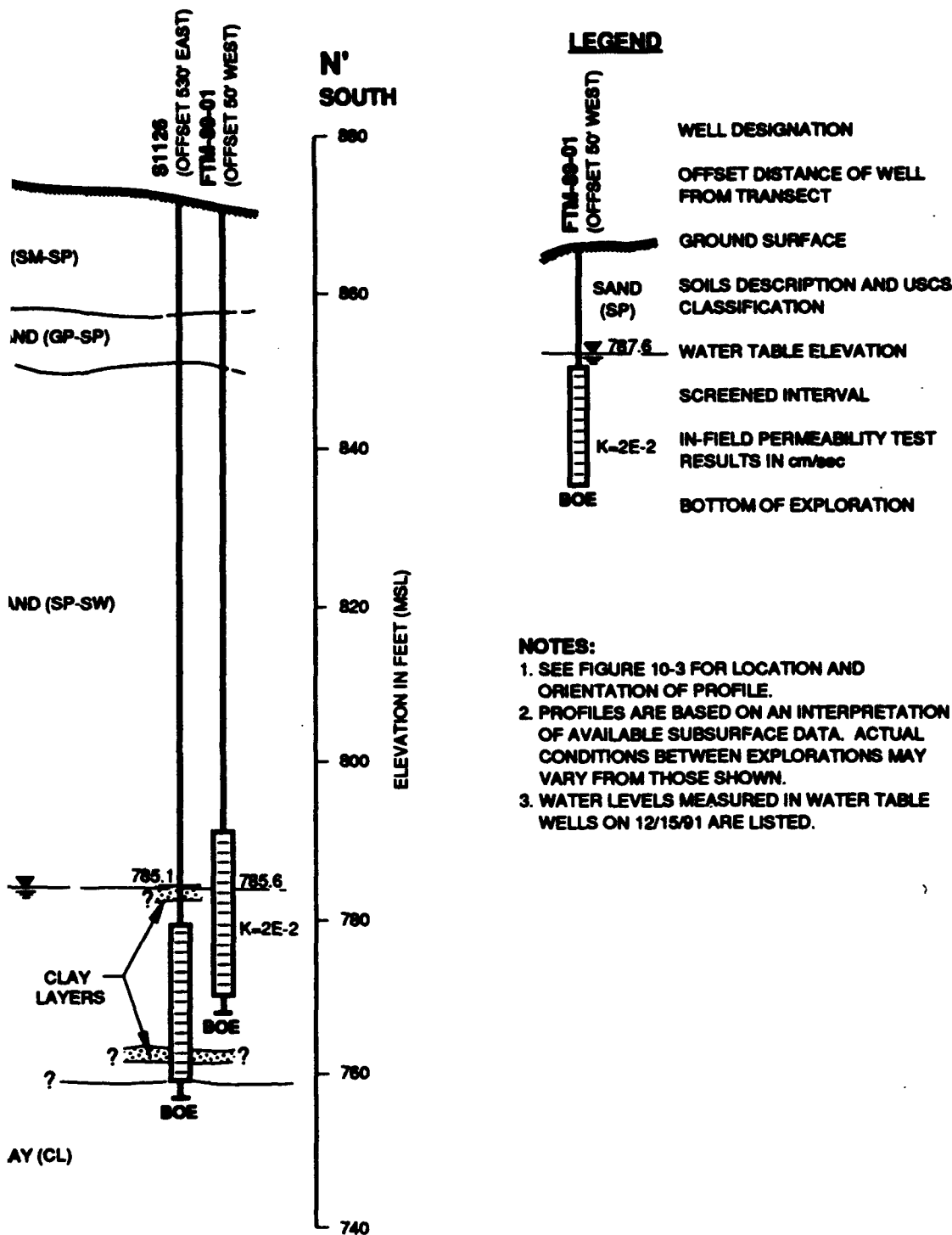






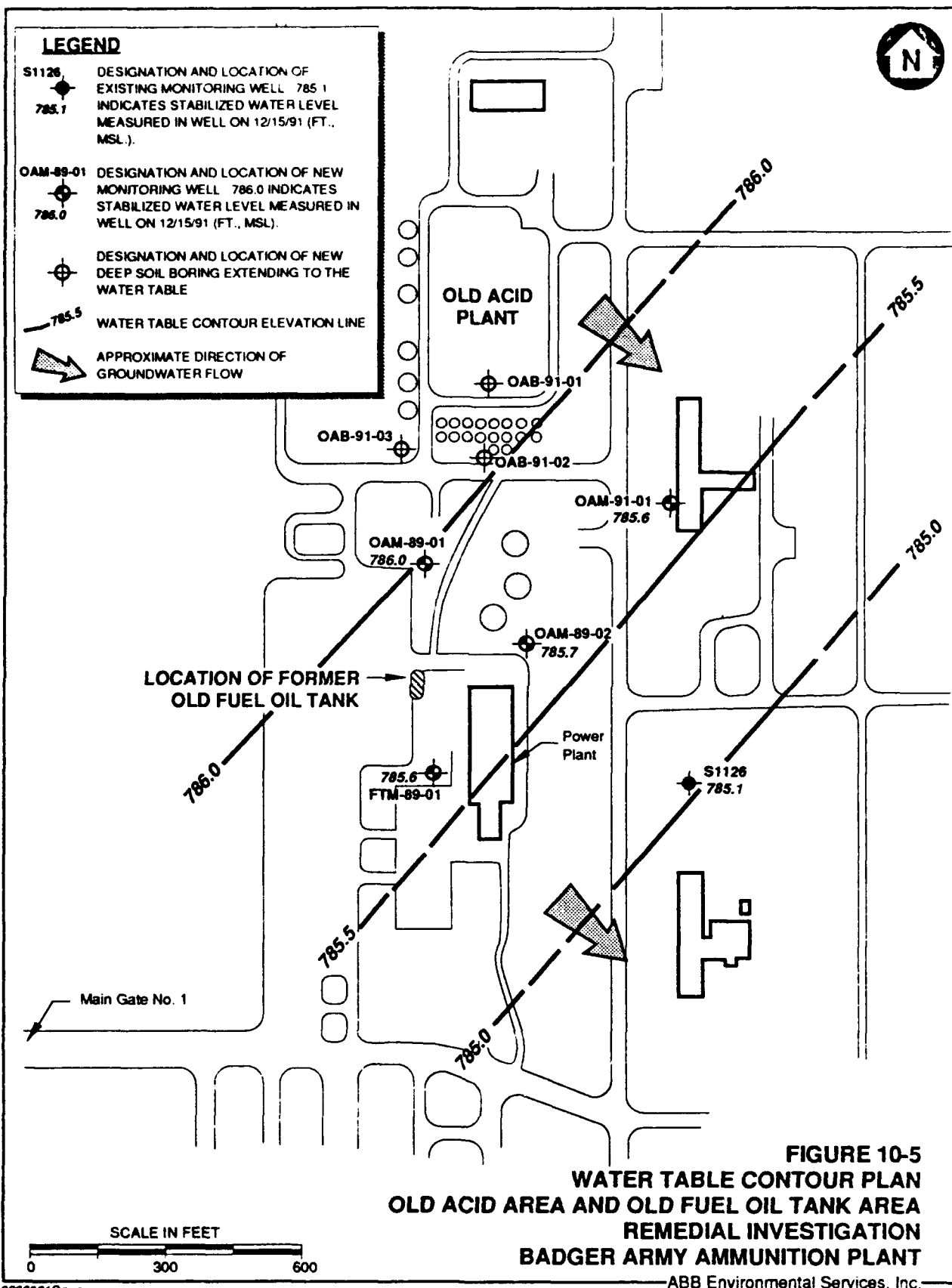
**GEOLOGIC CROSS SECTION  
OLD ACID AREA AND OLD FUEL OIL TANK  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION**



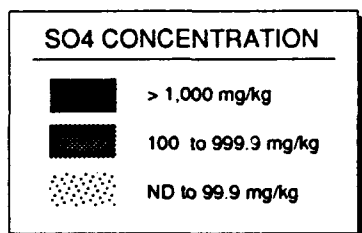
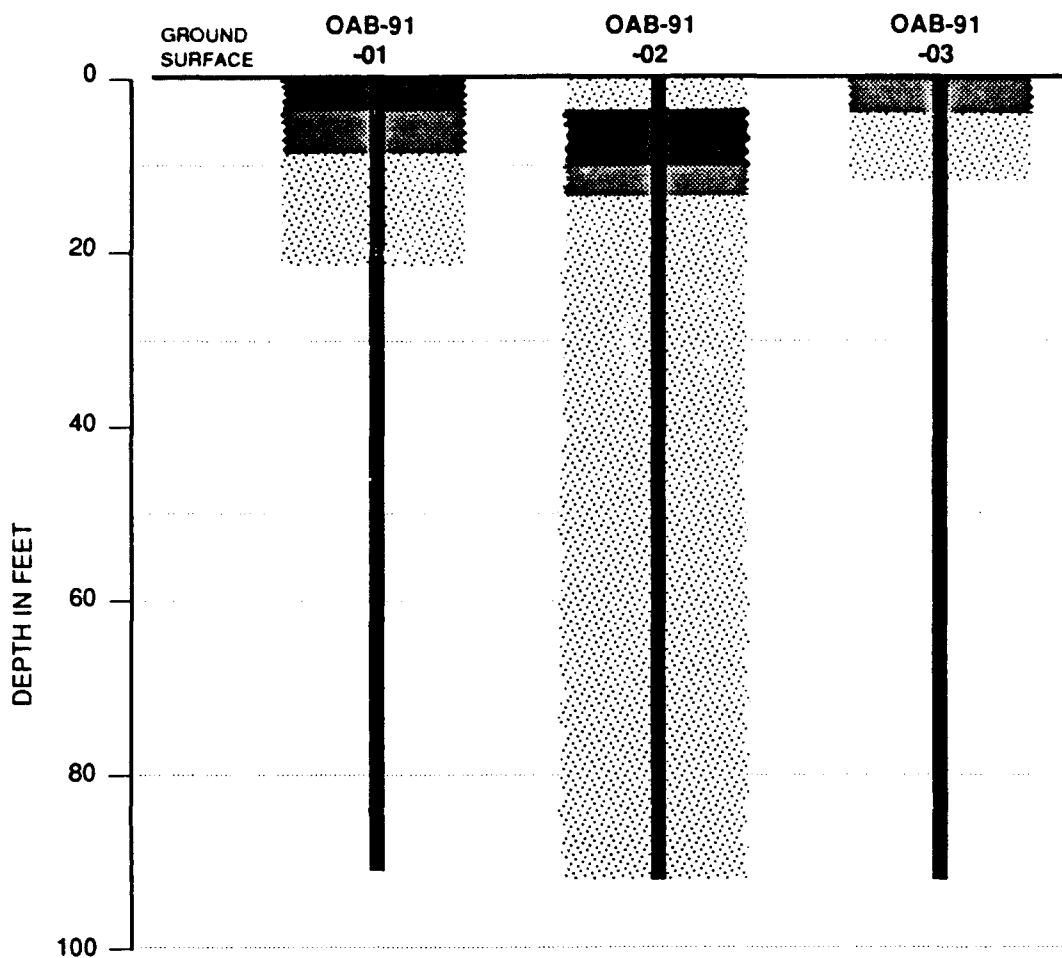


**FIGURE 10-4**  
**GEOLOGIC CROSS SECTION N-N'**  
**OLD ACID AREA AND OLD FUEL OIL TANK AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**









**NOTE:**

1. SEE TABLE 10-9 AND APPENDIX K FOR CHEMICAL DATA SUMMARY.

**FIGURE 10-6**  
**SO4 CONCENTRATIONS IN**  
**SUBSURFACE SOILS**  
**OLD ACID AREA**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



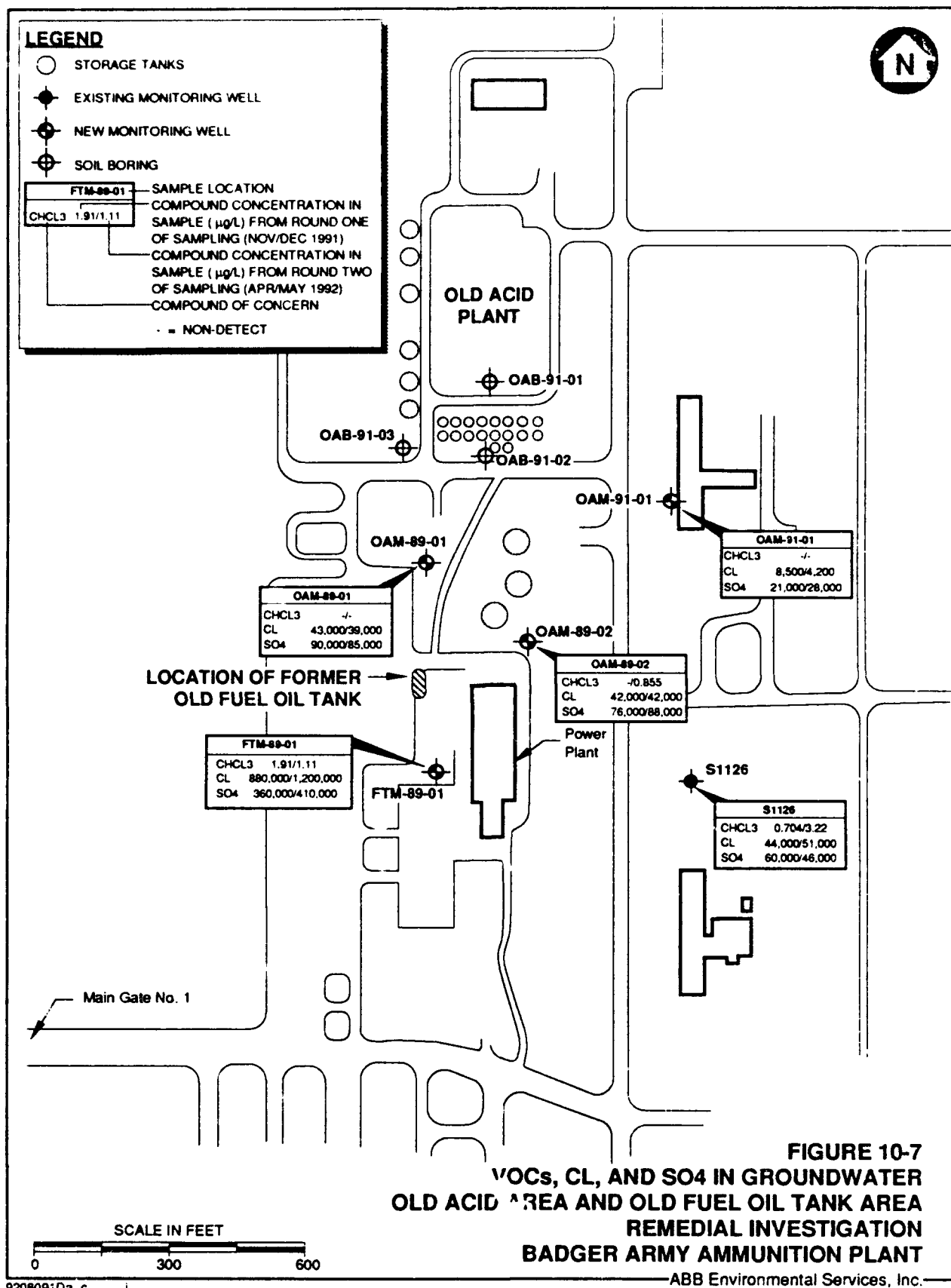




TABLE 11-1  
SUMMARY OF THE REMEDIAL INVESTIGATION FIELD PROGRAM -  
OFF-POST AREA SOUTH OF BAAP

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITES	PROGRAM ELEMENTS			
	SOIL VAPOR SURVEY	REMOTE SENSING GEOPHYSICS	MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING*	SOIL BORINGS AND SOIL SAMPLING
Off-Post Area South of BAAP	--	--	24 new wells; 48 samples from 24 new wells	--

Notes:

\* Includes 2 rounds of groundwater sampling



TABLE 11-2  
SUMMARY OF MONITORING WELLS INSTALLED -  
OFF-POST AREA SOUTH OF BAAP

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
PBM-90-01 D	Dual-wall driven casing	217.0	618.5	10	Downgradient and off-post of BAAP	To provide horizontal definition to the plume.
PBM-90-02 D	Dual-wall driven casing	214.0	614.2	10	Downgradient and off-post of BAAP	To provide horizontal definition of the plume.
PBM-90-03	Dual-wall driven casing	205.0	613.4	10	Downgradient and off-post of BAAP	To provide horizontal definition of the plume.
PBN-90-04 B -04 D	Dual-wall driven casing Dual-wall driven casing	B - 130.0 D - 237.0	B - 708 D - 627.5	10 10	Downgradient and off-post of BAAP adjacent to water tank	To provide horizontal and vertical definition of the plume.
PBN-91-01 C	Dual-wall driven casing	160.0	675.5	10	Downgradient and off-post of BAAP	In association with existing well PBM-90-01D, to provide horizontal and vertical plume definition.
PBN-91-02 B -02 C	Dual-wall driven casing Dual-wall driven casing	B - 115.0 C - 161.3	B - 704.0 C - 658.6	10 10	Downgradient and off-post of BAAP	In association with existing well PBM-90-02D, to provide horizontal and vertical plume definition.



continued

TABLE 11-2  
SUMMARY OF MONITORING WELLS INSTALLED -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
PBN-91-03 B -03 C	Dual-wall driven casing Dual-wall driven casing	B - 106.1 C - 152.3	B - 706.7 C - 660.0	10 10	Downgradient and off-post of BAAP	In association with existing well PBM-90-03D, to provide horizontal and vertical plume definition.
SWN-91-01 B -01 C -01 D	Dual-wall driven casing Dual-wall driven casing Dual-wall driven casing	B - 113.1 C - 160.1 D - 200.2	B - 717.1 C - 672.8 D - 633.4	10 10 10	Downgradient and off-post of BAAP along County HWY Z	To provide horizontal and vertical definition of the plume.
SWN-91-02 C -02 D	Dual-wall driven casing Dual-wall driven casing	C - 155.0 D - 190.2	C - 681.9 D - 649.5	10 10	Downgradient and off-post of BAAP along County HWY Z	To provide horizontal and vertical definition of the plume.
SWN-91-03 B -03 C -03 D -03 E	Dual-wall driven casing Dual-wall driven casing Dual-wall driven casing Dual-wall driven casing	B - 113.4 C - 162.8 D - 209.1 E - 258.0	B - 721.3 C - 671.8 D - 625.9 E - 597.1	10 10 10 10	Downgradient and off-post of BAAP along County HWY Z	To provide horizontal and vertical definition of the plume and to assess vertical gradient between bedrock and overburden
SWN-91-04 C -04 D	Dual-wall driven casing Dual-wall driven casing	C - 164.0 D - 197.0	C - 668.8 D - 636.5	10 10	Downgradient and off-post of BAAP along County HWY Z	To provide horizontal and vertical definition of the plume.



continued

TABLE 11-2  
SUMMARY OF MONITORING WELLS INSTALLED -  
OFF-POST AREA SOUTH OF BAAP

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SITE AND WELL IDENTIFIER	DRILLING METHOD	BORING DEPTH FROM GROUND SURFACE (ft.)	BOTTOM ELEVATION OF SCREENS (ft. MSL)	LENGTH OF WELL SCREEN (ft.)	LOCATION	PURPOSE
SWN-91-05 B	Dual-wall driven casing	B - 112.5	B - 718.0	10	Downgradient and off-post of BAAP along County HWY Z	To provide horizontal and vertical definition of the plume.
-05 C	Dual-wall driven casing	C - 147.0	C - 683.8	10		
-05 D	Dual-wall driven casing	D - 202.4	D - 630.7	10		



**TABLE 11-3**  
**WELLS INCLUDED IN GROUNDWATER SAMPLING PROGRAM -**  
**OFF-POST AREA SOUTH OF BAAP**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

SITES	NEW WELLS	EXISTING WELLS	RESIDENTIAL WELLS
Off-Post Area South of BAAP	PBM-90-01D PBM-90-02D PBM-90-03D PBN-90-04B,D PBN-91-01C PBN-91-02B,C PBN-91-03B,C SWN-91-01B,C,D SWN-91-02C,D SWN-91-03B,C,D,E SWN-91-04C,D SWN-91-05B,C,D	None	Graf Premo Shaefer Spear
<b>TOTAL WELLS</b>	<b>24</b>	<b>0</b>	<b>4</b>

**Notes:**

B,C,D,E - Shallowest to deepest: B indicates shallowest; E indicates deepest well in a well nest.



TABLE 11-4  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
OFF-POST AREA SOUTH OF BAAPPRIVATE WELLS

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

[illegible]



TABLE 11-4  
CHEMICAL ANALYSES PERFORMED ON GROUNDWATER SAMPLES -  
OFF-POST AREA SOUTH OF BAAP/PRIVATE WELLS

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

SAMPLE LOCATION	INORGANICS																		ORGANICS					TPH
	METALS								ANIONS			OTHER												
	PP	TAL	CA	NA	CD	CR	HG	PB	NI	NIT	CL	SO4	HARD	ALK	TDS	TOC	NH3N2	VOC	BNVA	MG	NAM	DNT		
PRIVATE WELLS																								
PREMO	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B	--
SCHAEFER	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B	--
SPEAR	--	B	--	--	--	--	--	--	--	B	B	B	B	B	B	B	--	B	B	B	B	B	B	--
GRAF	--	2	--	--	--	--	--	--	--	2	2	2	2	2	2	2	--	2	B	--	--	--	--	--

## NOTES:

PP = Priority Pollutant Metals (13) (AG, AS, BE, CD, CR, CU, PB, HG, NI, SB, SE, TL, ZN)  
TAL = Toxic Analyte List (23) (AL, SB, AS, BA, BE, CD, CA, CR, CO, CU, FE, PB, MG, MN, HG, NI, K, SE, AG, NA, TL, V, ZN)

VOC = volatile organic compounds by GC/MS

GC/MS = Gas Chromatography/Mass Spectrometry

BNVA = base-neutral and acid-extractable organics by GC/MS

NAM = nitroamines by GC

DNT = 2,4- and 2,6-dinitrotoluene by HPLC

HPLC = High Performance Liquid Chromatography

\* = Wells were analyzed for select VOCs during Round I (September 1990) and Round II (October 1990).

B = Analyzed in both Rounds (One and Two).

1 = Analyzed in Round One Only.

2 = Analyzed in Round Two Only.

USA018.wk1



**TABLE 11-5**  
**FIELD HYDRAULIC CONDUCTIVITY TEST RESULTS -**  
**OFF-POST AREA SOUTH OF BAAP**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>WELL DESIGNATION</b>	<b>MAXIMUM WATER LEVEL DEPRESSION (FEET)</b>	<b>HYDRAULIC CONDUCTIVITY (CM/SEC)</b>	<b>GEOLOGIC CONDITIONS</b>
SWN-91-03B	5.8	$2.6 \times 10^{-2} \text{ }^a$	Coarse sand and gravel (SP-GP)
SWN-91-03C	8.0	$1.8 \times 10^{-2} \text{ }^a$	Medium to coarse sand (SP)
SWN-91-03D	4.9	$1.5 \times 10^{-2} \text{ }^a$	Coarse sand (SP)
SWN-91-03E	7.8	$1.0 \times 10^{-3}$	Sandstone and dolomite bedrock

**Notes:**

Field data and calculations are presented in Appendix I. Hydraulic conductivities were calculated using the HVORSLEV method.

Hydraulic Conductivity Tests were completed during March and November, 1989, and November and December 1991.

Values for hydraulic conductivities represent an averaged value of multiple tests performed on each well.

<sup>a</sup> Water level recovery at this well was impacted by inertial effects, resulting in water level recovery above static water levels. Hydraulic conductivity measurements may be greater than the calculated values at this well.

cm/sec = centimeters per second



TABLE 11-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBM-90-01D	PBM-90-01D	PBM-90-01D	PBM-90-02D	PBM-90-02D	PBM-90-03D
Sample Type:	WELL	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	09/24/90	10/22/90	12/15/91	04/24/92	09/25/90	10/23/90
ROUND:	I	II	ONE	TWO	I	II
VOCs						
ACET	-	-	-	-	-	-
CCL4	-	-	-	-	-	-
CH2CL2	-	-	4.8	6.67	2.16	3.53
CHCL3	-	-	-	B	4.02	P
MEK	-	-	-	-	0.553	P
TRCLE	-	-	-	-	-	-
SVOCs						
2E1HXL	-	-	-	-	-	-
B2EHP	-	-	-	-	-	-
Metals						
BA	-	-	-	-	-	-
CA	-	-	2.78	-	-	-
CD	-	-	8.47	-	-	-
CR	-	-	-	-	-	-
FE	-	-	-	-	-	-
HG	-	-	-	-	-	-
K	-	-	-	-	-	-
MG	-	-	-	-	-	-
MN	-	-	-	-	-	-
NA	-	-	-	-	-	-
PB	-	-	-	-	-	-
Anions						
NIT	-	-	6700	5600	5200	3200
CL	-	-	31000	29000	6800	8100
SO4	-	-	59000	52000	38000	39000
Indicator						
ALK	-	-	231000	262000	269000	200000
HARD	-	-	256000	338000	370000	284000
TDS	-	-	479000	404000	272000	303000
pH(1)	7.5	7.7	7.7	7.8	7.5	7.6
Sp.Cond.(2)	586	522	543	642	534	463
						395

Notes and flagging codes are presented at the end of this table.



TABLE 11-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: ROUND:	PBM-90-03D		PBM-90-04B		PBN-90-04B		PBN-90-04D		PBN-90-04D		
	WELL UGL	12/14/91 ONE	04/28/92 TWO	09/25/90 I	10/23/90 II	12/15/91 ONE	04/24/92 TWO	09/25/90 I	10/23/90 II	12/15/91 ONE	04/24/92 TWO
VOCs											
ACET	-	-	-	-	-	-	-	-	-	-	-
CCL4	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	4.9	P	7.25 B	-	-	4.41 P	7.45 B	-	-	4.31 P	7.45 B
CHCL3	-	-	-	-	-	-	-	-	-	-	-
MEK	36.0	S	-	-	-	-	60.0 S	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-	-
SVOCs											
2EHXL	-	-	-	-	-	20.0 S	-	-	-	90.8	71.8
B2EHP	-	-	-	-	-	-	-	-	-	-	-
Metals											
BA	-	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-
CR	13.8	-	-	-	-	4.63	-	-	-	5.72	-
FE	-	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-
Anions											
NIT	5300	5200	-	-	-	8500	7500	-	-	6500	6100
CL	7300	8700	-	-	-	6300	7300	-	-	5000	5200
SO4	18000	19000	-	-	-	18000	19000	-	-	15000	16000
ALK	220000	228000	-	-	-	242000	218000	-	-	210000	218000
HARD	278000	282000	-	-	-	346000	274000	-	-	244000	274000
TDS	335000	303000	-	-	-	340000	288000	-	-	388000	288000
pH(1)	7.8	7.9	-	7.6	7.5	7.7	7.9	7.6	7.7	7.7	8.0
SpCond.(2)	414	477	-	453	573	310	462	440	400	302	446

Notes and flagging codes are presented at the end of this table.



TABLE 11-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	PBN-91-01C	PBN-91-02B	PBN-91-02C	PBN-91-03B	PBN-91-03C
Sample Type:	WELL	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/15/91	04/24/92	12/07/91	12/14/91	04/28/92
ROUND:	ONE	TWO	ONE	ONE	TWO
VOCs					
ACET	-	-	-	-	-
CCL4	-	2.94 P	-	-	-
CH2CL2	4.8 P	6.76 B	4.9 P	4.71 P	7.84 B
CHCL3	-	0.493 P	-	-	-
MEK	-	-	39 S	-	40 S
TRCLE	-	-	-	-	-
SVOCs					
2E1HXL	-	-	-	-	-
B2EHP	30.3 P	39.8 P	25.5 P	-	29.8 P
Metals					
BA	-	-	79.6	-	255
CA	-	-	-	-	-
CD	-	-	-	-	-
CR	5.55	-	6.67	6.06	4.61
FE	-	-	-	-	-
HG	-	-	-	-	-
K	-	-	-	-	-
MG	-	-	-	-	-
MN	-	-	-	-	-
NA	-	-	-	-	-
PB	-	-	-	-	-
Anions					
NIT	10000	9000	19000	19000	7900
CL	37000	37000	24000	29000 P	25000 P
SO4	63000	59000	49000	28000	21000
Indicator					
ALK	284000	222000	520000	227000	228000
HARD	330000	366000	370000	368000	314000
TDS	543000	272000	369000	463000	323000
pH(1)	7.6	7.7	8.4	7.6	7.8
Sp.Cond.(2)	592	716	691	577	487

Notes and flagging codes are presented at the end of this table.



TABLE 11-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: T/NTS: DATE SAMPLED: ROUND:	SWN-91-01B			SWN-91-01C			SWN-91-01D			SWN-91-02C			SWN-91-02D		
	WELL			WELL			WELL			WELL			WELL		
	12/14/91	04/25/92	ONE	12/14/91	04/25/92	ONE	12/14/91	04/25/92	ONE	12/14/91	04/26/92	ONE	12/14/91	04/26/92	ONE
VOCs															
ACET	-	-	13	S	-	-	-	-	-	-	-	-	-	-	-
CCl4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CH2CL2	4.71	6.76 B	4.8	P	5.98	B	4.51	P	6.18	B	5.69	B	4.9	P	6.47
CHCL3	-	-	-	-	-	-	-	-	-	-	0.433	P	-	-	-
MEK	-	-	64	S	79	S	-	-	-	-	-	-	-	-	-
TRCLE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SVOCs															
2EHL	10	-	30	S	-	-	-	-	-	-	-	-	-	-	-
BZHP	62.1	-	105	-	-	-	127	-	-	-	50.8	P	104	-	104
Metals															
BA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	4.82	-	14.5	-	-	-	7.18	-	-	-	-	-	-	-	-
FE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anions															
NIT	13000	11000 X	10000	P	9200	7900	30000	P	8800	14000	16000	5300	5300	5300	5300
CL	33000	36000	26000	P	27000	36000	36000	P	30000	31000	31000	14000	17000	17000	17000
SO4	37000	37000	35000	-	36000	36000	36000	-	36000	48000	49000	36000	39000	39000	39000
ALK	246000	260000	220000	-	258000	256000	256000	-	278000	316000	200000	208000	196000	196000	196000
HARD	354000	358000	316000	-	378000	340000	340000	-	338000	354000	374000	278000	294000	294000	294000
TDS	504000	405000	391000	-	401000	545000	545000	-	401000	512000	263000	359000	251000	251000	251000
pH(1)	7.5	7.7	7.6	-	7.7	7.5	7.5	-	7.7	7.4	7.7	7.7	7.9	7.9	7.9
SpCond.(2)	422	611	389	-	564	394	394	-	568	424	673	328	519	519	519

Notes and flagging codes are presented at the end of this table.



TABLE II-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID: Sample Type: UNITS: DATE SAMPLED: ROUND:	SWN-91-03B			SWN-91-03C			SWN-91-03D			SWN-91-03E			SWN-91-04C		
	12/11/91 ONE	04/28/92 TWO	WELL UGL	12/11/91 ONE	04/27/92 TWO	WELL UGL	12/11/91 ONE	04/27/92 TWO	WELL UGL	12/11/91 ONE	04/27/92 TWO	WELL UGL	12/14/91 ONE	04/25/92 TWO	WELL UGL
VOCs															
ACET	-	-	7.1	-	-	-	-	-	-	-	-	-	47	S	-
CCl4	7.25	10.8	2.75	-	3.33	P	-	-	-	-	-	-	-	-	-
CH2CL2	4.71	7.16 B	4.71	4.71	7.84	B	4.9	7.75	P	4.9	7.75	B	4.51	P	7.06 B
CHCL3	1.31	1.21	-	-	-	-	-	-	-	-	-	-	-	-	-
MEK	68	130 S	38	5.5	-	S	5.4	-	S	5.4	-	S	42	S	51 S
TRCLE	-	0.287 P	-	0.425	-	P	-	-	-	-	-	-	-	-	-
SVOCs															
2E1HXL	-	-	-	30	-	S	10.0	-	S	10.0	-	-	-	-	-
B2EHP	50.8	62.1	49.4	73.2	139	-	24.8	74.8	-	24.8	74.8	-	66.9	-	-
Metals															
BA	-	-	-	-	-	-	74000	624.3	-	74000	624.3	-	-	-	-
CA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CR	5.42	-	-	5.16	-	-	5.0	-	-	5.0	-	-	7.14	-	-
FE	-	-	-	-	-	-	27.4	-	-	27.4	-	-	-	-	-
HG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	968	1520	T	968	1520	T	-	-	-
MG	-	-	-	-	-	-	32000	29000	-	32000	29000	-	-	-	-
MN	-	-	-	-	-	-	54.1	29.7	-	54.1	29.7	-	-	-	-
NA	-	-	-	-	-	-	25000	27000	T	25000	27000	T	-	-	-
PB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NIT	18000	14000	1800	5300	1300	-	5000	4400	-	5000	4400	-	7200	6000	-
CL	23000	23000	3100	8000	10000	P	20000	20000	P	20000	20000	P	14000	15000	-
SO4	41000	42000	18000	33000	22000	-	57000	54000	-	57000	54000	-	39000	42000	-
ALK	314000	274000	224000	238000	232000	-	250000	230000	-	250000	230000	-	242000	260000	-
HARD	348000	396000	260000	212000	256000	-	294000	402000	-	294000	402000	-	298000	330000	-
TDS	443000	419000	269000	319000	297000	-	376000	251000	-	376000	251000	-	525000	377000	-
pH(1)	8.2	7.5	8.1	8.3	7.9	-	8.7	7.8	-	8.7	7.8	-	7.7	7.7	-
Sp.Cond.(2)	714	572	445	568	523	-	629	566	-	629	566	-	492	542	-

Notes and flagging codes are presented at the end of this table.



TABLE II-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA -  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Site ID:	SWN-91-04D	SWN-91-05B	SWN-91-05C	SWN-91-05D
Sample Type:	WELL	WELL	WELL	WELL
UNITS:	UGL	UGL	UGL	UGL
DATE SAMPLED:	12/14/91	04/26/92	12/14/91	04/26/92
ROUND:	ONE	TWO	ONE	TWO
VOCs				
ACET	11 S	-	-	18 S
CCL4	-	-	-	-
CH2CL2	4.41 P	6.86 B	4.31 P	7.84 B
CHCL3	-	-	-	-
MEK	-	8.8 S	35 S	16 S
TRCLE	-	-	-	-
SVOCs				
2EHXL	-	-	-	-
B2EHP	55.7	31.8 P	31.8 P	39.8 P
Metals				
BA	-	-	-	-
CA	-	-	-	-
CD	-	-	-	-
CR	6.42	-	-	5.94
FE	-	-	-	-
HG	-	-	-	-
K	-	-	-	-
MG	-	-	-	-
MN	-	-	-	-
NA	-	-	-	-
PB	-	-	-	-
Anions				
NIT	3100	4100	7900	5200
CL	3800	4900	39000	33000
SO4	19000	21000	59000	63000
Indicator				
ALK	266000	234000	248000	224000
HARD	244000	290000	314000	305000
TDS	323000	211000	435000	463000
pH(1)	7.8	7.8	7.6	7.6
Sp. Cond. (2)	400	438	568	555
				602

Notes and flagging codes are presented at the end of this table.



TABLE 11-6  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	=	unitless
(2)	=	Specific conductivity, umhos/cm
UGL	=	Micrograms per liter (parts per billion)
VOCs	=	Volatile organic compounds
SVOCs	=	Semi-volatile organic compounds
Blank cell	=	No analysis performed
.	=	Less than the Certified Reporting Limit (CRL)
GT	=	Greater than the reported value
B	=	Analyte found in blank as well as sample
G	=	Reported results affected by interferences or high background
P	=	Results less than CRL, but greater than Criteria of Detection
R	=	Analyte required for reporting purposes, but not currently certified
S	=	Results based on internal standard
T	=	Uncertified analyte in a certified method
X	=	Analyte recovery outside of certified range, but within acceptable limits

Appendix K contains complete analytical results

USATHAMA chemical codes are defined in the RI Report Glossary



Site ID:	GRAF	PREMO				SCIAEFER			SPEAR
Sample Type:	WELL	WELL				WELL			WELL
DATE SAMPLED:	UGL	UGL				UGL			UGL
ROUND:	TWO	ONE	04/09/92	12/04/91	04/09/92	12/04/91	04/09/92	12/04/91	04/09/92
			TWO	ONE	TWO	ONE	TWO	ONE	TWO
VOCs	CH2CL2	B	5.88	P	5.69	B	3.82	P	5.88
	CHCL3	-	-	P	0.584	P	-	-	-
Metals	AS	-	-	-	-	-	3.28	-	-
	BA	60	31.4	-	28.5	-	95	31.9	33.3
	BE	0.358	-	-	-	-	98	-	-
	CA	130000	82000	-	76000	-	64000	74000	74000
	CR	-	23.8	-	-	-	28.6	19.6	-
	CU	6.31	-	-	7.66	-	-	-	4.63
	FE	-	1200	-	78.9	-	2600	110	-
	HG	-	-	-	-	-	-	-	-
	K	2850	968	T	1540	T	915	1660	2510
	MG	12000	43000	-	39000	-	34000	39000	39000
	MN	193	8.93	-	-	X	234	-	-
	NA	16000	22000	T	20000	T	3060	-	14000
	NI	-	-	-	-	-	10	-	-
	ZN	330	190	-	178	X	224	167	117
Anions	NIT	570	8000	X	8800	-	1800	9300	8100
	CL	17000	49000	-	51000	-	9500	13000	13000
	SO4	60000	36000	X	35000	-	23000	44000	42000
Indicator parameter	ALK	292000	220000	-	270000	-	270000	256000	302000
	HARD	346000	330000	-	292000	-	292000	306000	354000
	TDS	412000	444000	-	413000	-	336000	412000	388000
pH(1)	7.8	8.4	7.8	8.3	8.1	8.1	7.8	7.8	7.8
SpCond(2)	637	92	746	432	520	520	650	516	650

**Notes and flagging codes are presented at the end of this table.**



TABLE 11-7  
SUMMARY OF GROUNDWATER CHEMICAL DATA-  
PRIVATE WELLS  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

Notes and flagging codes:

(1)	"	unitless
(2)	"	Specific conductivity, umhos/cm
UGL	"	Micrograms per liter (parts per billion)
VOCs	"	Volatile organic compounds
SVOCs	"	Semi-volatile organic compounds
Blank cell	"	No analysis performed
.	"	Less than the Certified Reporting Limit (CRL)
GT	"	Greater than the reported value
B	"	Analyte found in blank as well as sample
G	"	Reported results affected by interferences or high background
P	"	Results less than CRL, but greater than Criteria of Detection
R	"	Analyte required for reporting purposes, but not currently certified
S	"	Results based on internal standard
T	"	Uncertified analyte in a certified method
X	"	Analyte recovery outside of certified range, but within acceptable limits

USATHAMA chemical codes are defined in the RJ Report Glossary



TABLE 11-8  
CHEMICAL AND PHYSICAL PROPERTIES OF VOCs DETECTED IN GROUNDWATER  
OFF-POST AREA SOUTH OF BAAP

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

CHEMICALS	CAS#	MOLECULAR WEIGHT (g/mole)	DENSITY (ml/g)	WATER SOLUBILITY (mg/l)	VAPOR PRESSURE (mmHg)	HENRY'S LAW CONSTANT (atm- m <sup>3</sup> /mole)	K <sub>ow</sub> <sup>b</sup> (ml/g)	K <sub>ow</sub> <sup>c</sup> (ml/ml)
<u>Volatile Organic Compounds</u>								
CCL4	56-23-5	154	1.594	7.57x10 <sup>2</sup>	90	2.41x10 <sup>-2</sup>	110	437
CHCL3	67-66-3	119	1.483	8.2x10 <sup>2</sup>	150.5	2.88x10 <sup>-3</sup>	44	91
TRCLE	79-01-6	132	1.45	1.1x10 <sup>3</sup>	57.9	9.1x10 <sup>-3</sup>	126	240

Notes:

<sup>a</sup> All data from the Risk Assessment Guidance for Superfund (USEPA, 1989a).

<sup>b</sup> K<sub>ow</sub> = partition coefficient between the organic chemical and carbon.

<sup>c</sup> K<sub>ow</sub> = partition coefficient of the chemical between octanol and water.

See the List of USATHAMA Chemical Codes in the Glossary for definitions of chemical abbreviations.



TABLE 11-9  
ESTIMATE OF DISTANCE TRAVELED BY CCL4 IN GROUNDWATER -  
OFF-POST AREA SOUTH OF BAAP

REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

$$V_c = V/[1 + K_d (b/n)] \quad K_d = K_{oc} * f_{oc}$$

Assume: Fraction of organic carbon ( $f_{oc}$ ) = 0.003

Soil density ( $b$ ) = 2 g/ml

Soil porosity ( $n$ ) = 0.3

A weighted-average groundwater flow velocity ( $V$ ) along a flow  
line from the Propellant Burning Ground to the Wisconsin River:

$$V = (0.55)*(330 \text{ ft/yr}) + (0.45)*(440 \text{ ft/yr}) \\ \cong 440 \text{ ft/yr}$$

VOC	CONTAMINANT VELOCITY $V_c$ , (FT/YR.)	PARTITION COEFFICIENT $K_d$ , (ml/g)	$K_{oc}$	YEARS	DISTANCE TRAVELED (FT.)
CCL4	137.5	0.33	110	50	6.875

The approximate minimum distance that TRCLE has been transported in groundwater is 13,000 ft., in approximately 26 years.

The velocity of TRCLE ( $V_c$ ) in groundwater is:

$$V_c = 13,000 \text{ ft}/26 \text{ yrs.}$$

$$= 500 \text{ ft/yr (slightly greater than groundwater flow rate)}$$

Assume CCL4 moves at rate of groundwater flow (440 ft/yr):

$$\text{Estimated distance CCL4 has traveled} = (440 \text{ ft/yr}) * (50 \text{ yrs}) \\ = 22,000 \text{ feet} \\ \text{or 4.2 miles}$$



TABLE 11-10  
COMPARISON OF GROUNDWATER TO STANDARDS -  
UNITS:  $\mu\text{g}/\text{l}$   
OFF-POST AREA SOUTH OF BAAP

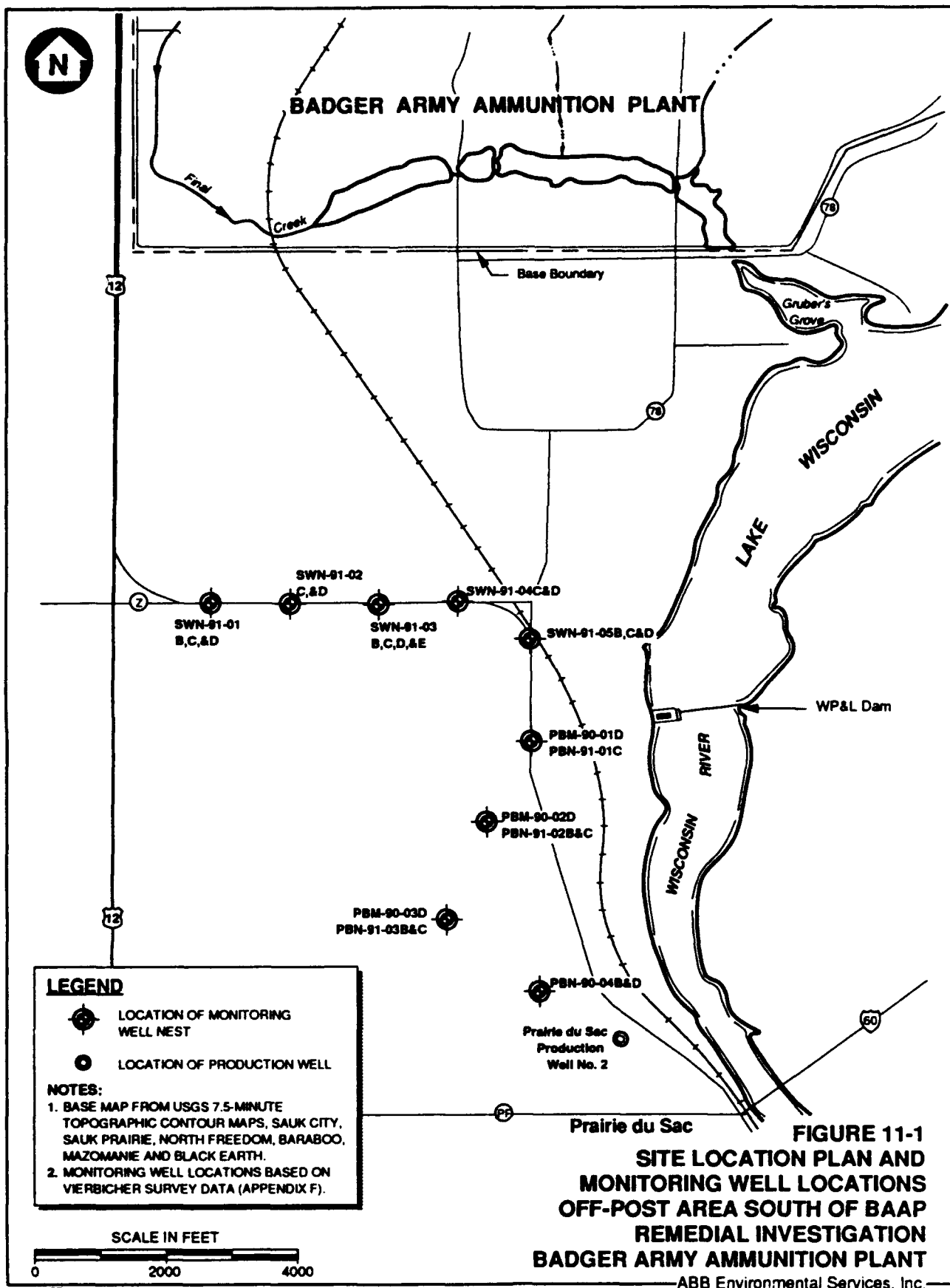
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

COMPOUNDS OF POTENTIAL CONCERN	FREQUENCY OF DETECTION	MAXIMUM DETECTED CONCENTRATION	MINIMUM DETECTED CONCENTRATION	SDWA (1)		WI GROUNDWATER STANDARDS (2)		CALCULATED CONCENTRATION (3)
				MCL	MCLG	ES	PAL	
BA	2:2	24.8	24.3	2,000	2,000	1,000(c)	200(c)	-
CCL4	8:52	10.8	1.68	5	0	5	0.5	-
CD	1:42	2.78	-	5	5	10(d)	1(d)	-
CHCL3	6:52	1.31	0.433	-	-	6	0.6	-
CL	42:42	49,000	3,100	250,000(a)	-	-	-	-
CR	16:42	14.5	4.61	100	100	50(e)	5(e)	-
MN	2:2	54.1	29.7	50(a)	-	50(f)	25(f)	-
NA	2:2	27,000	25,000	20,000(b)	-	-	-	-
NIT	42:42	27,000	1,300	10,000	10,000	10,000	2,000	-
PB	1:42	5.6	-	TT	0	50(g)	5(g)	-
SO4	42:42	64,000	18,000	250,000(a)	-	250,000(f)	125,000(f)	-
TRCLE	2:52	0.425	0.287	5	0	5	0.18	-

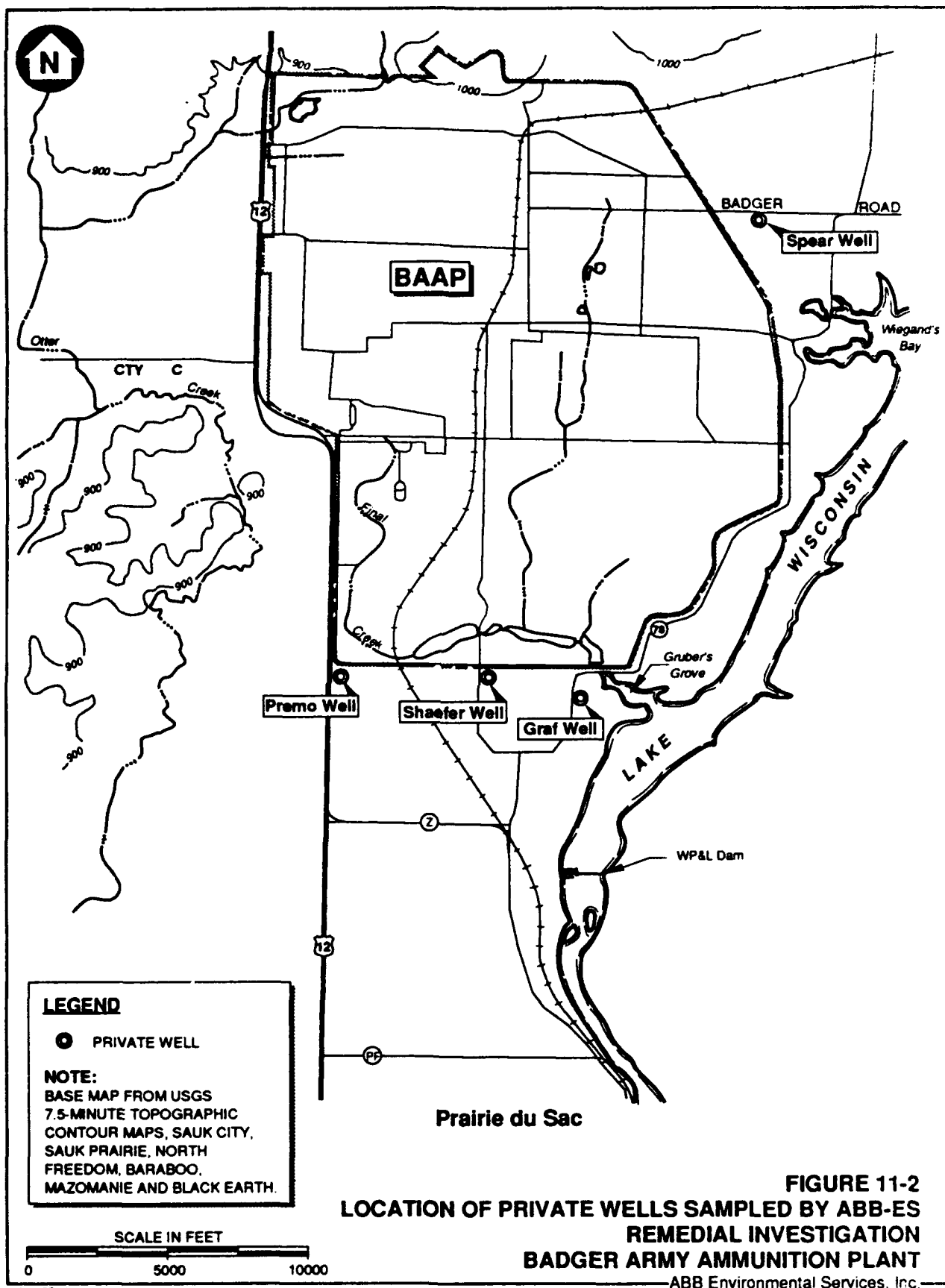
Sources:

- (1) U.S. Environmental Protection Agency (EPA), 1991, "Fact Sheet: National Primary Drinking Water Standards," Office of Water, Washington, D.C., August 1991; EPA, 1991, "Fact Sheet: National Secondary Drinking Water Standards," Office of Water, Washington, D.C., September 1991; and EPA, 1990, "National Primary and Secondary Drinking Water Regulations: Synthetic Organic Chemicals and Inorganic Chemicals, Final Rule," 57FR31776, July 17, 1992 (see Subsection 3.6 for details).
- (2) Wisconsin Administrative Code, Chapter NR 140.10, Table 1 (see Subsection 3.6 for details).
- (3) Calculated to be protective at risk of  $10^{-6}$  or  $10^{-4}$  (see Subsection 4.5 for details).
- Notes:
- (a) Secondary drinking water standard, suggested level.
- (b) Reporting level. Monitoring is required and data is reported to health officials to protect individuals on restricted sodium diet.
- (c) WI proposing change to ES = 2,000  $\mu\text{g}/\text{l}$  and PAL = 400  $\mu\text{g}/\text{l}$
- (d) WI proposing change to ES = 5  $\mu\text{g}/\text{l}$  and PAL = 0.5  $\mu\text{g}/\text{l}$
- (e) WI proposing change to ES = 100  $\mu\text{g}/\text{l}$  and PAL = 10  $\mu\text{g}/\text{l}$
- (f) Values for protection of public welfare (usually aesthetic concerns) rather than for protection of public health.
- (g) WI proposing change to ES = 15  $\mu\text{g}/\text{l}$  and PAL = 1.5  $\mu\text{g}/\text{l}$ .
- $\mu\text{g}/\text{l}$  = micrograms per liter
- SDWA = Safe Drinking Water Act
- MCL = Maximum Contaminant Level
- MCLG = Maximum Contaminant Level Goal
- WI = Wisconsin
- ES = Enforcement Standard
- PAL = Preventive Action Limit
- TT = Treatment technique requirement in effect
- Copper action level = 1,300  $\mu\text{g}/\text{l}$
- Lead action level = 15  $\mu\text{g}/\text{l}$

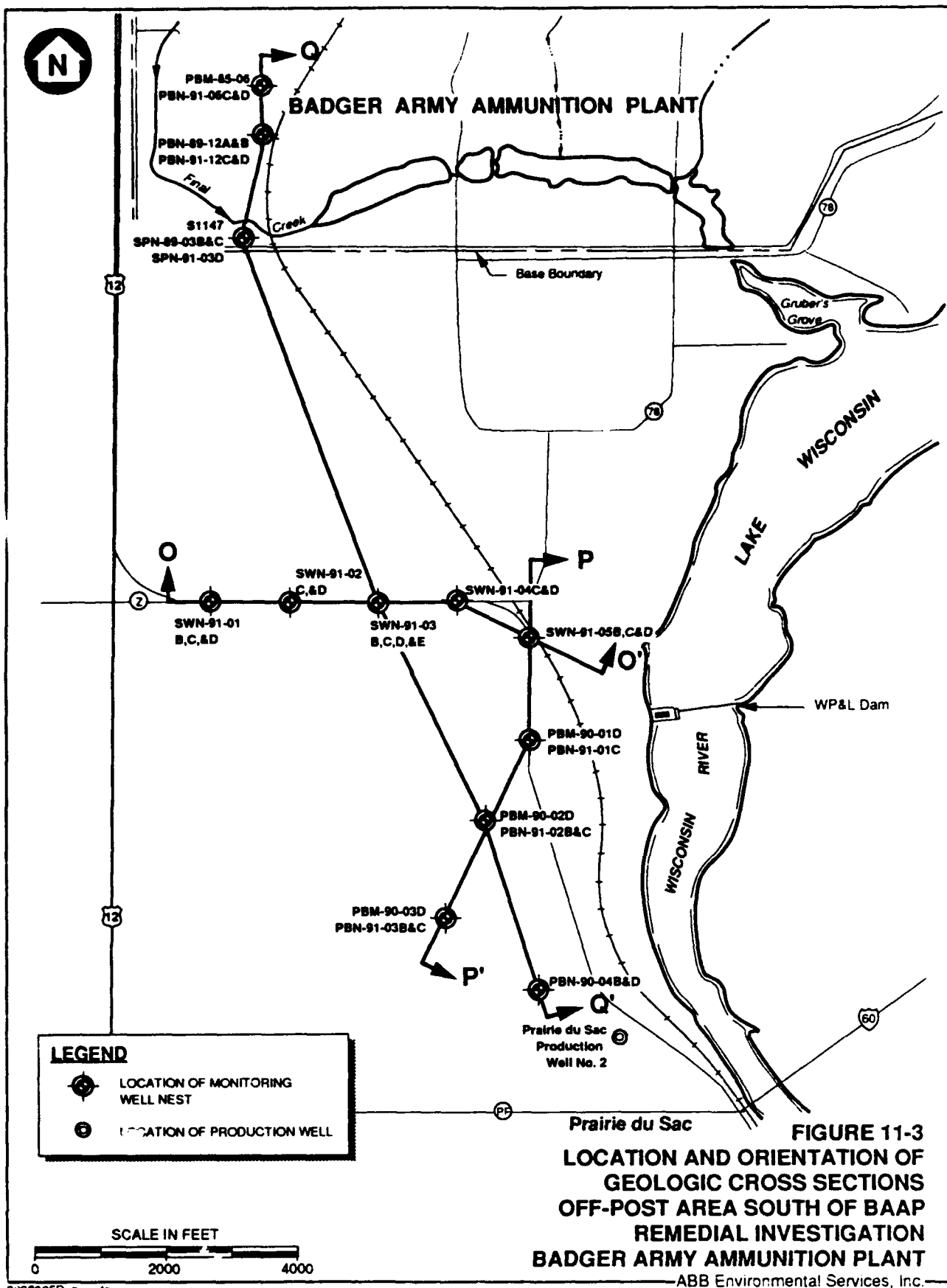




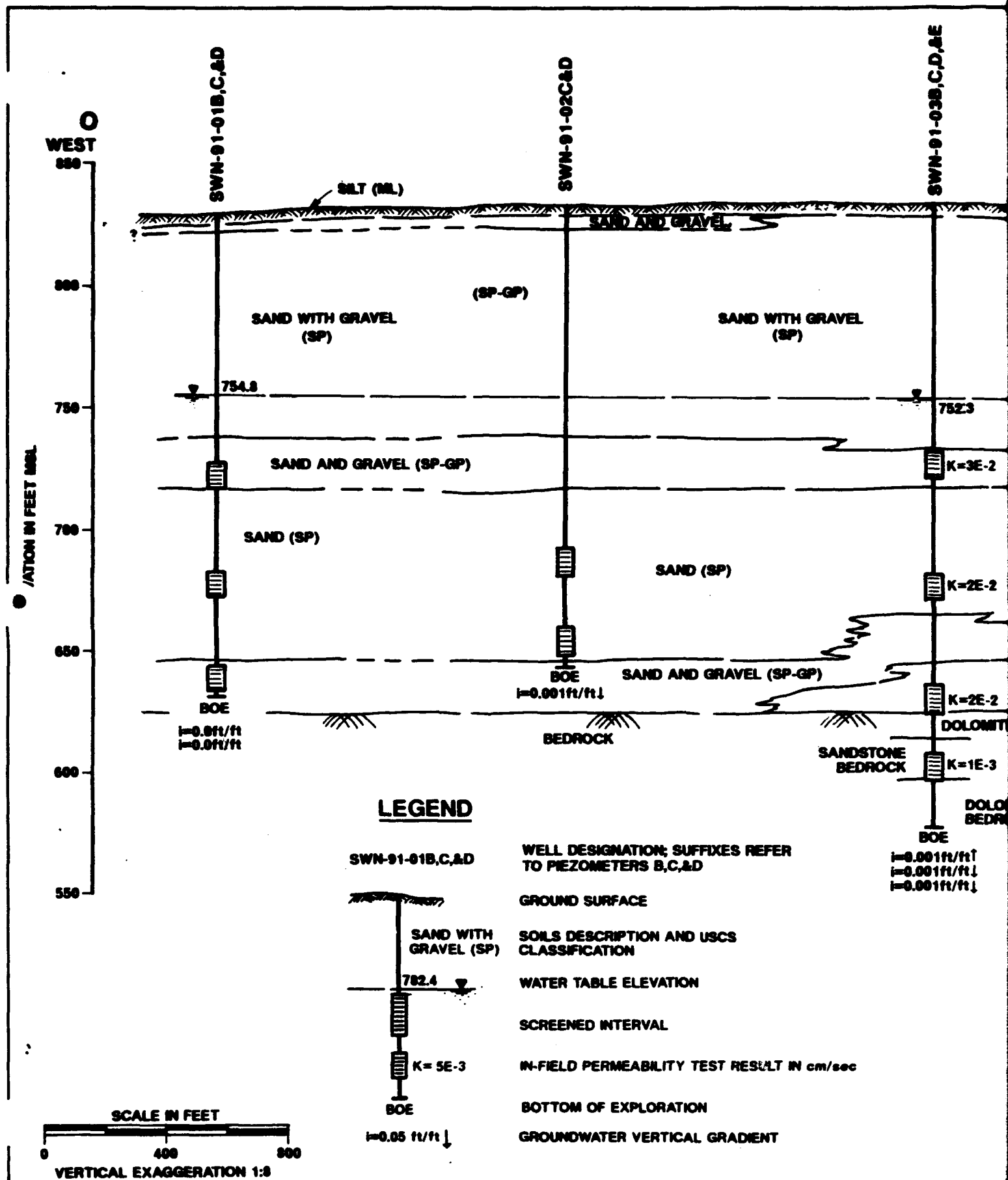












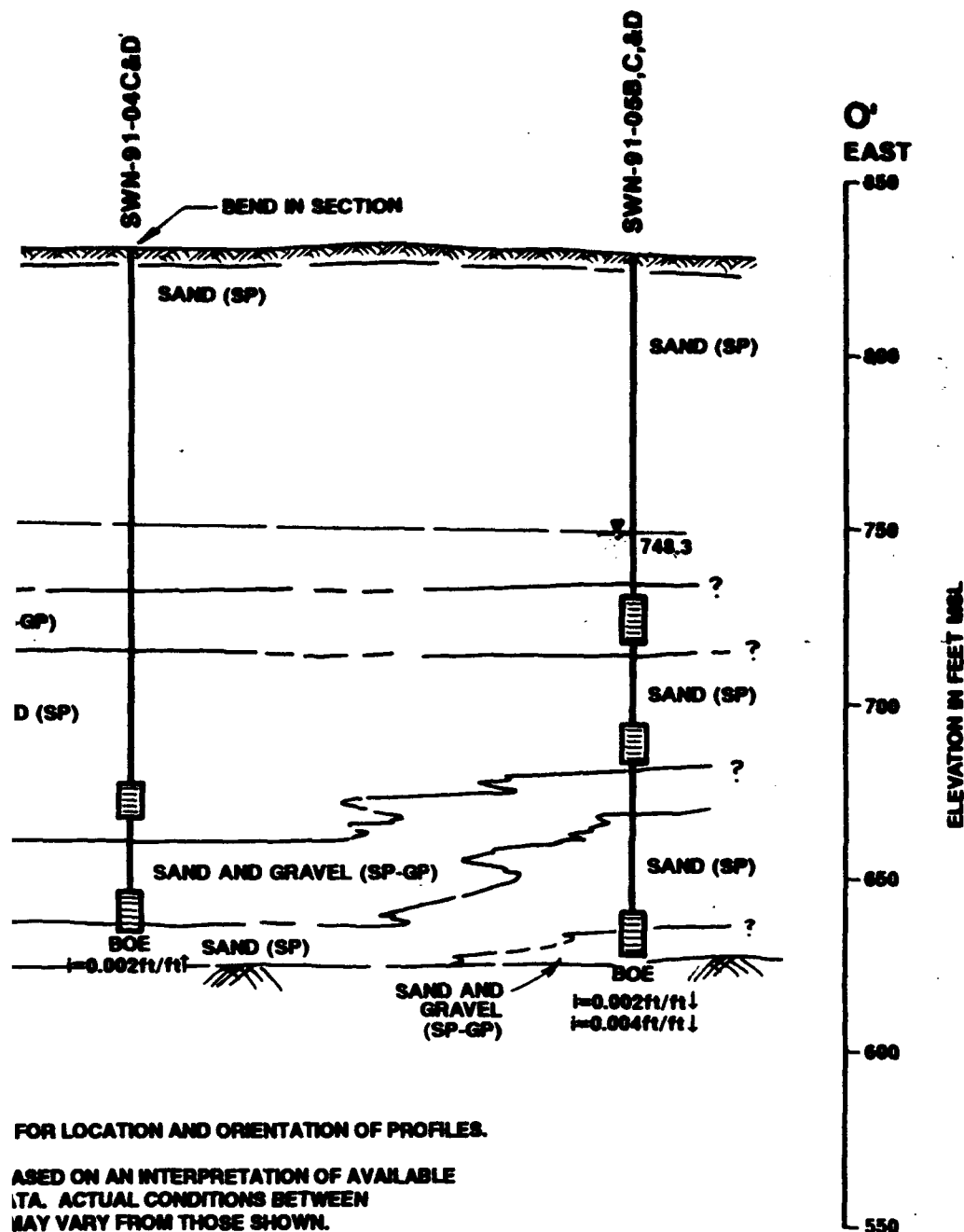


- NOTES:**

1. SEE FIGURE 11-3 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. ON MULTIPLE WELL NESTS, GRADIENTS ARE LISTED IN ORDER OF SHALLOW TO DEEP WELLS; B TO C, C TO D, AND D TO E.
4. WATER LEVELS MEASURED IN B-SERIES PIEZOMETERS ON 12/15/91 ARE LISTED.
5. BEDROCK SURFACE ELEVATION ESTIMATED FROM SWN-91-03D&E.

**FIGURE 1**  
**GEOLOGIC CROSS SECTION**  
**OFF-POST AREA SOUTH OF**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION RANGE**  
**— ABB Environmental Services**





FOR LOCATION AND ORIENTATION OF PROFILES.

BASED ON AN INTERPRETATION OF AVAILABLE DATA. ACTUAL CONDITIONS BETWEEN PROFILES MAY VARY FROM THOSE SHOWN.

ALL NESTS, GRADIENTS ARE LISTED IN ORDER OF DEPTH; B TO C, C TO D, AND D TO E.

MEASURED IN B-SERIES PIEZOMETERS ON 12/15/91

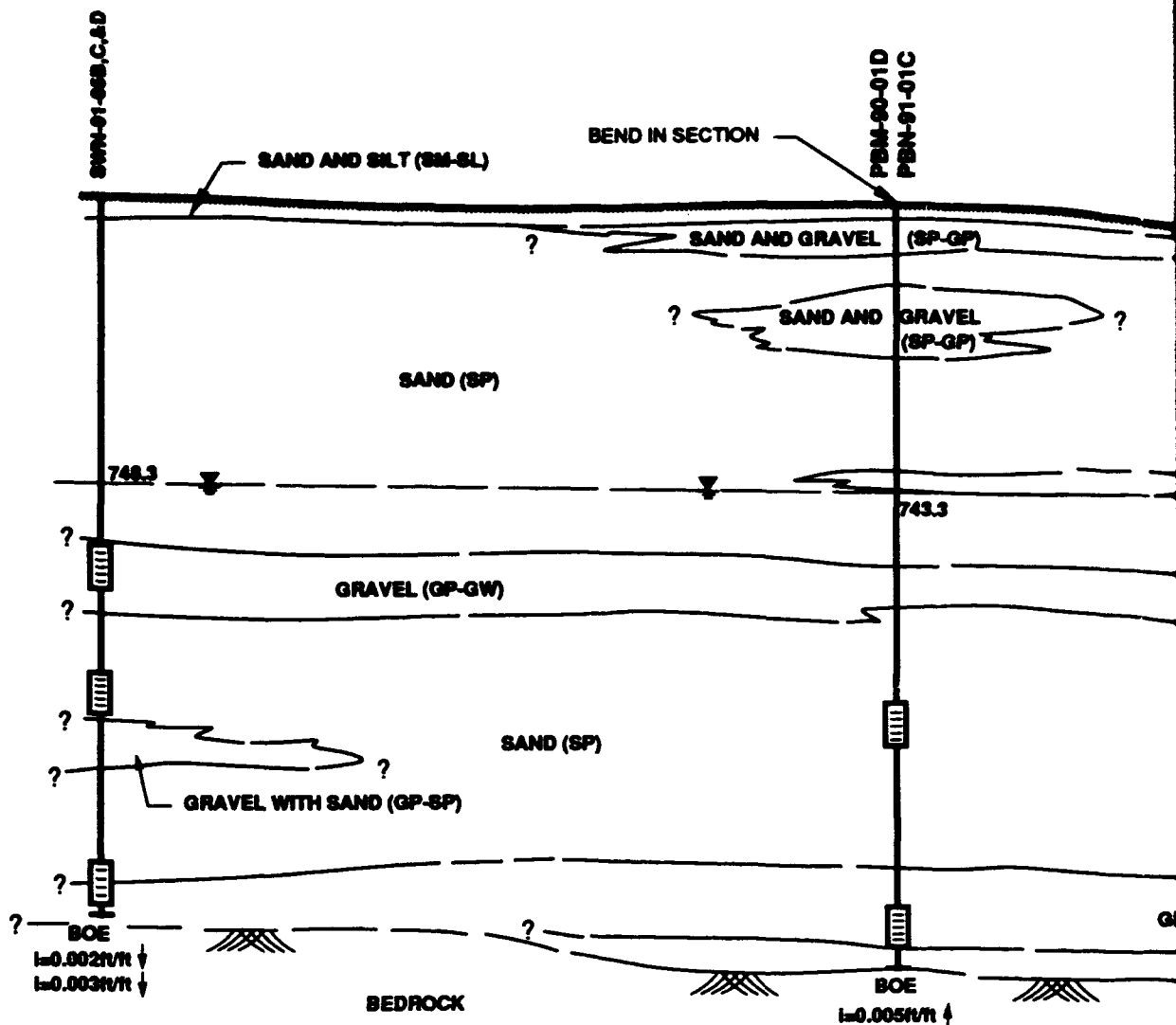
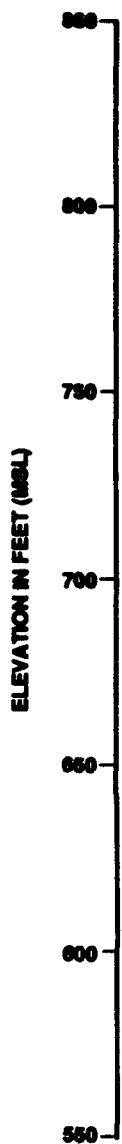
ICE ELEVATION ESTIMATED FROM SWN-91-03D&E.

**FIGURE 11-4  
GEOLOGIC CROSS SECTION O-O'  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

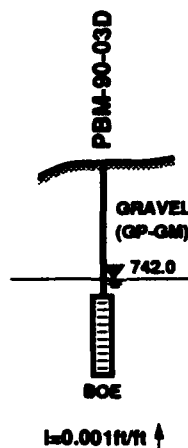
ABB Environmental Services, Inc.



P  
NORTH



# LEGEND



WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B&C)

GROUND SURFACE

SOILS DESCRIPTION AND USCS CLASSIFICATION

WATER TABLE ELEVATION

SCREENED INTERVAL

BOTTOM OF EXPLORATION

GROUNDWATER VERTICAL GRADIENT

## NOTES:

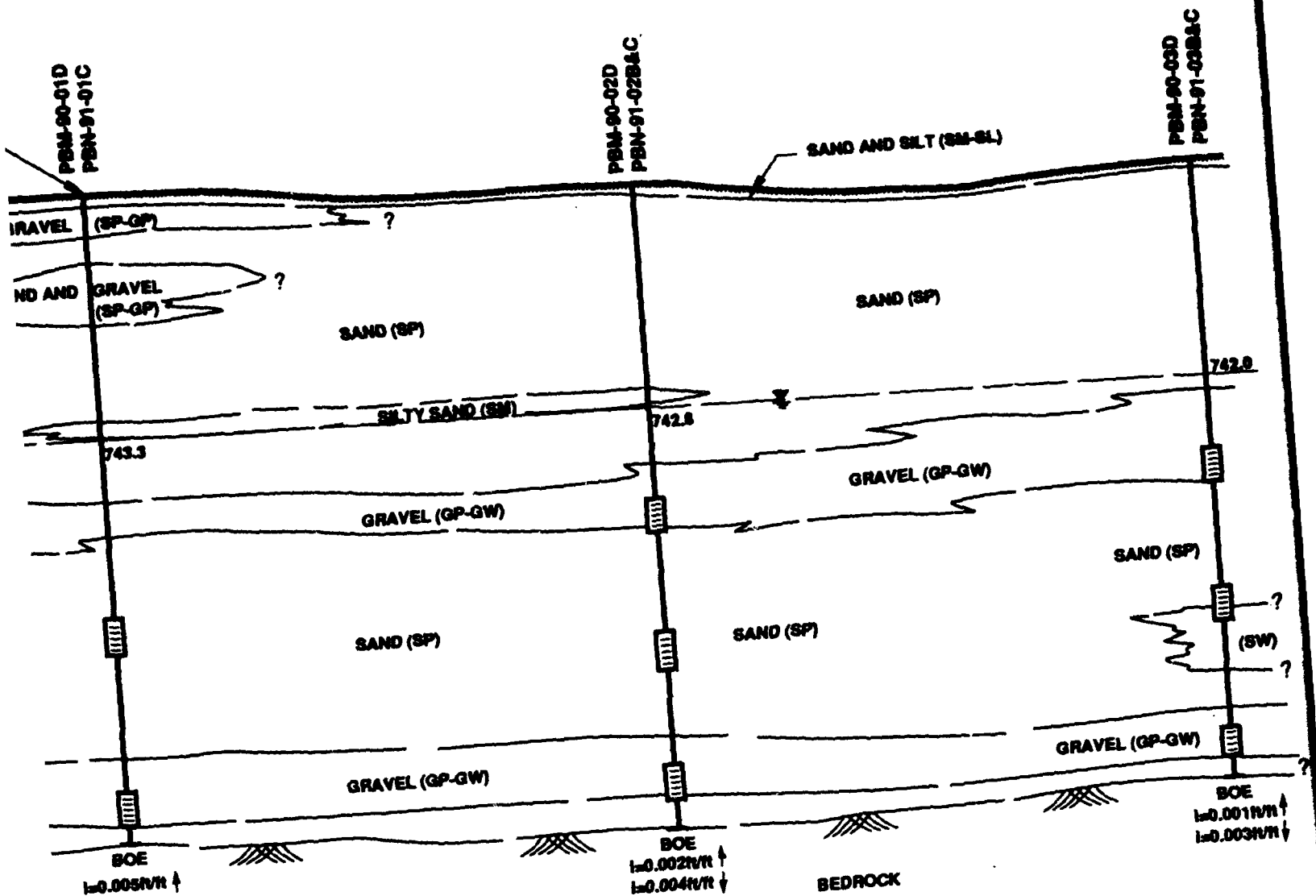
1. SEE FIGURE 11-3 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91.



VERTICAL EXAGGERATION 1:8



2



IGNITION: SUFFIXES REFER  
TABLE WELL (A) AND  
ER (B&C)

SURFACE

SCRIPTION AND USCS  
ATION

BLE ELEVATION

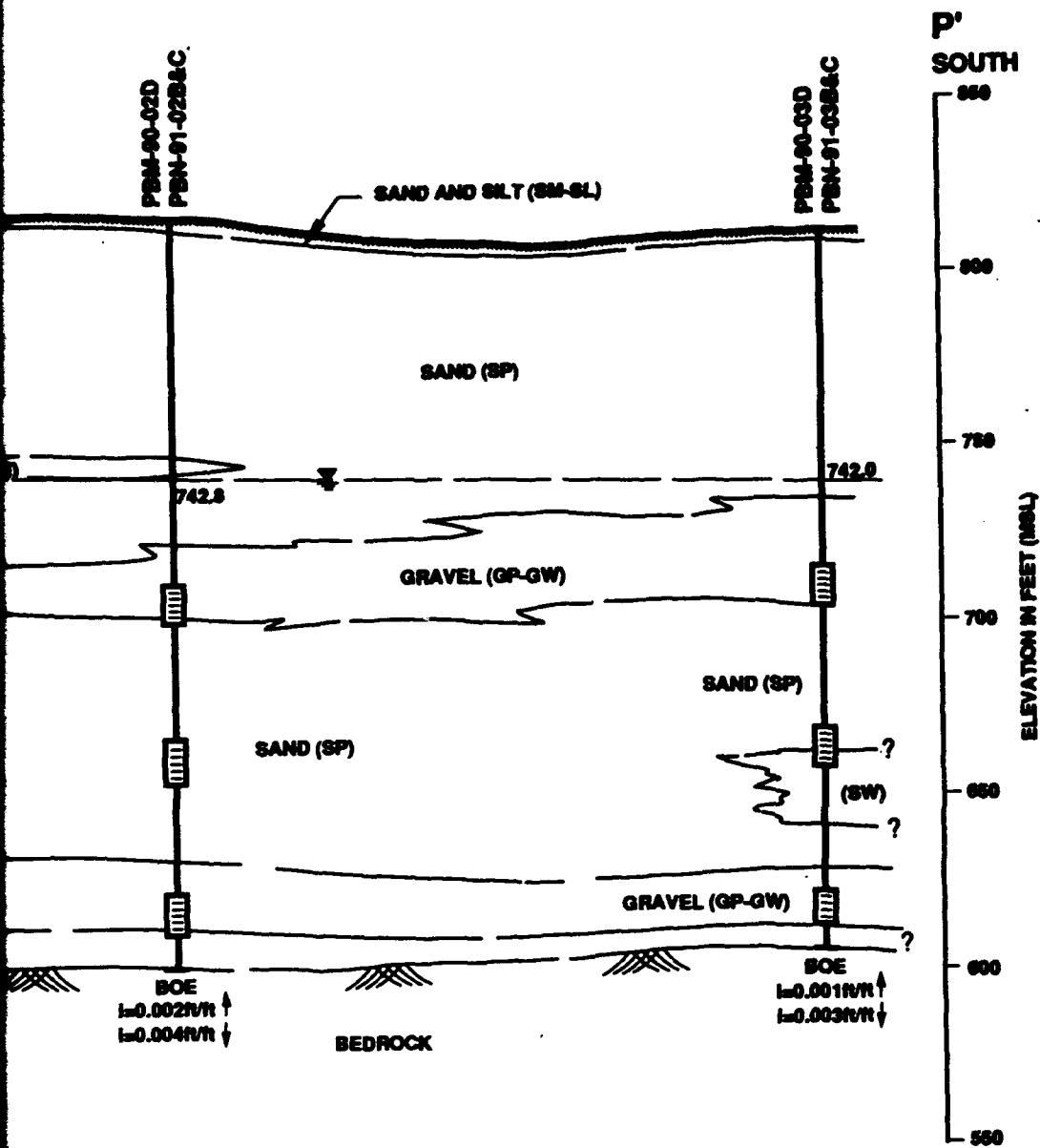
D INTERVAL

IF EXPLORATION

WATER VERTICAL GRADIENT

**GEOLOGIC CROSS SECTION  
OFF-POST AREA SOUTH  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION  
ABB Environmental**





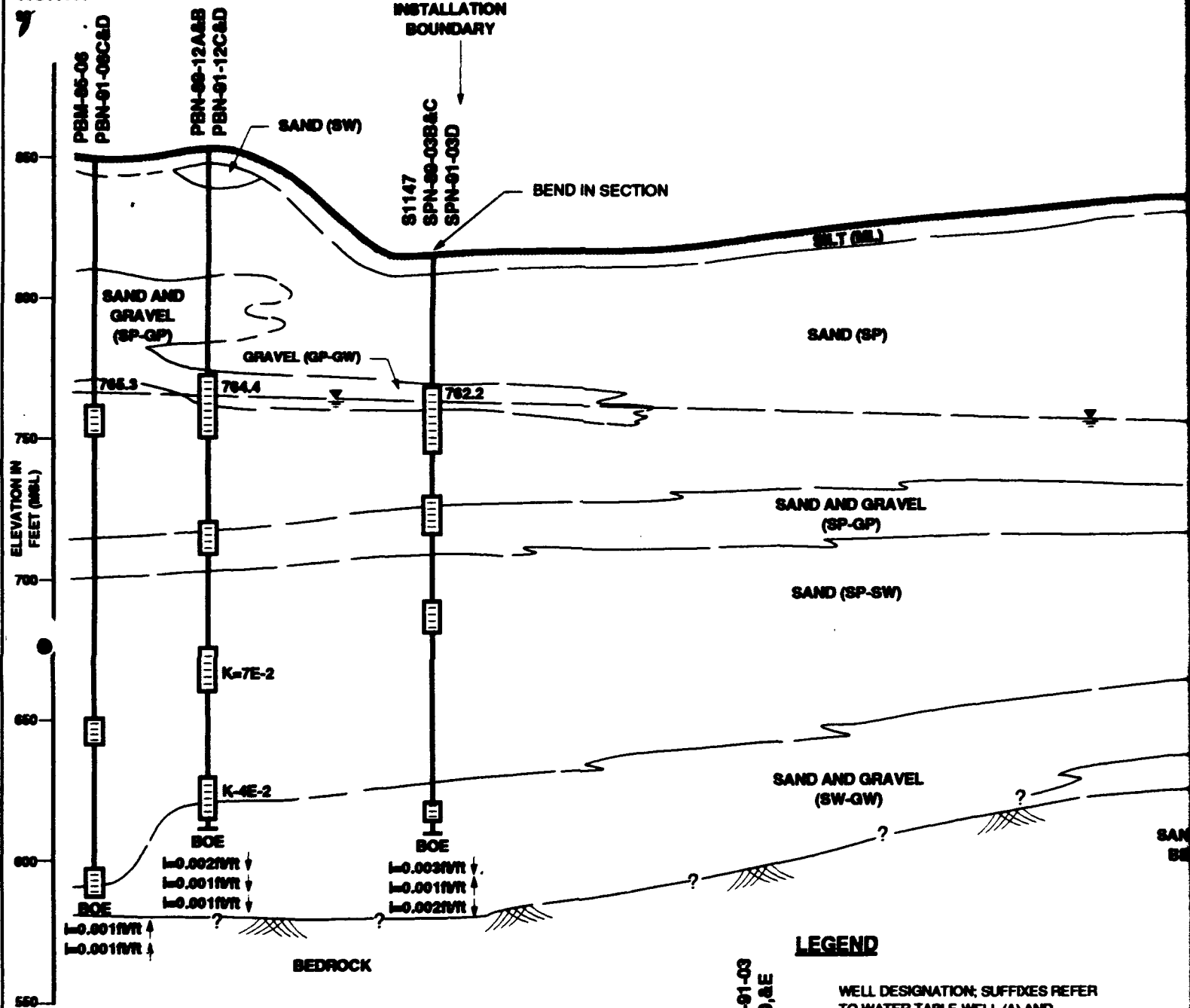
**FIGURE 11-5**  
**GEOLOGIC CROSS SECTION P-P'**  
**OFF-POST AREA SOUTH OF BAAP**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



Q  
NORTH

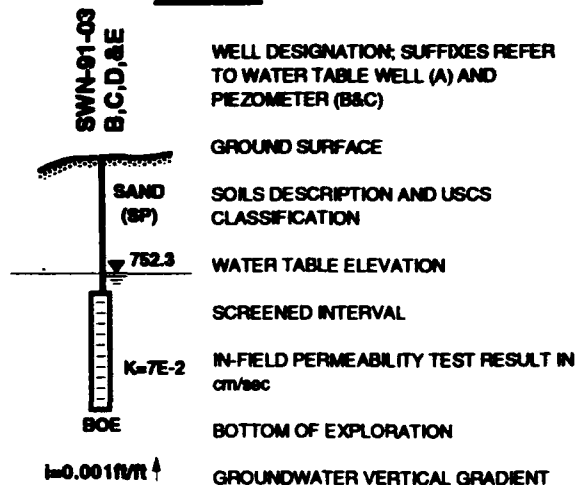
SOUTHERN  
INSTALLATION  
BOUNDARY



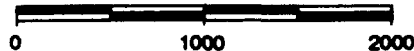
**NOTES:**

1. SEE FIGURE 11-3 FOR LOCATION AND ORIENTATION OF PROFILES.
2. PROFILES ARE BASED ON AN INTERPRETATION OF AVAILABLE SUBSURFACE DATA. ACTUAL CONDITIONS BETWEEN EXPLORATIONS MAY VARY FROM THOSE SHOWN.
3. WATER LEVELS MEASURED IN WATER TABLE WELLS ON 12/15/91.

**LEGEND**

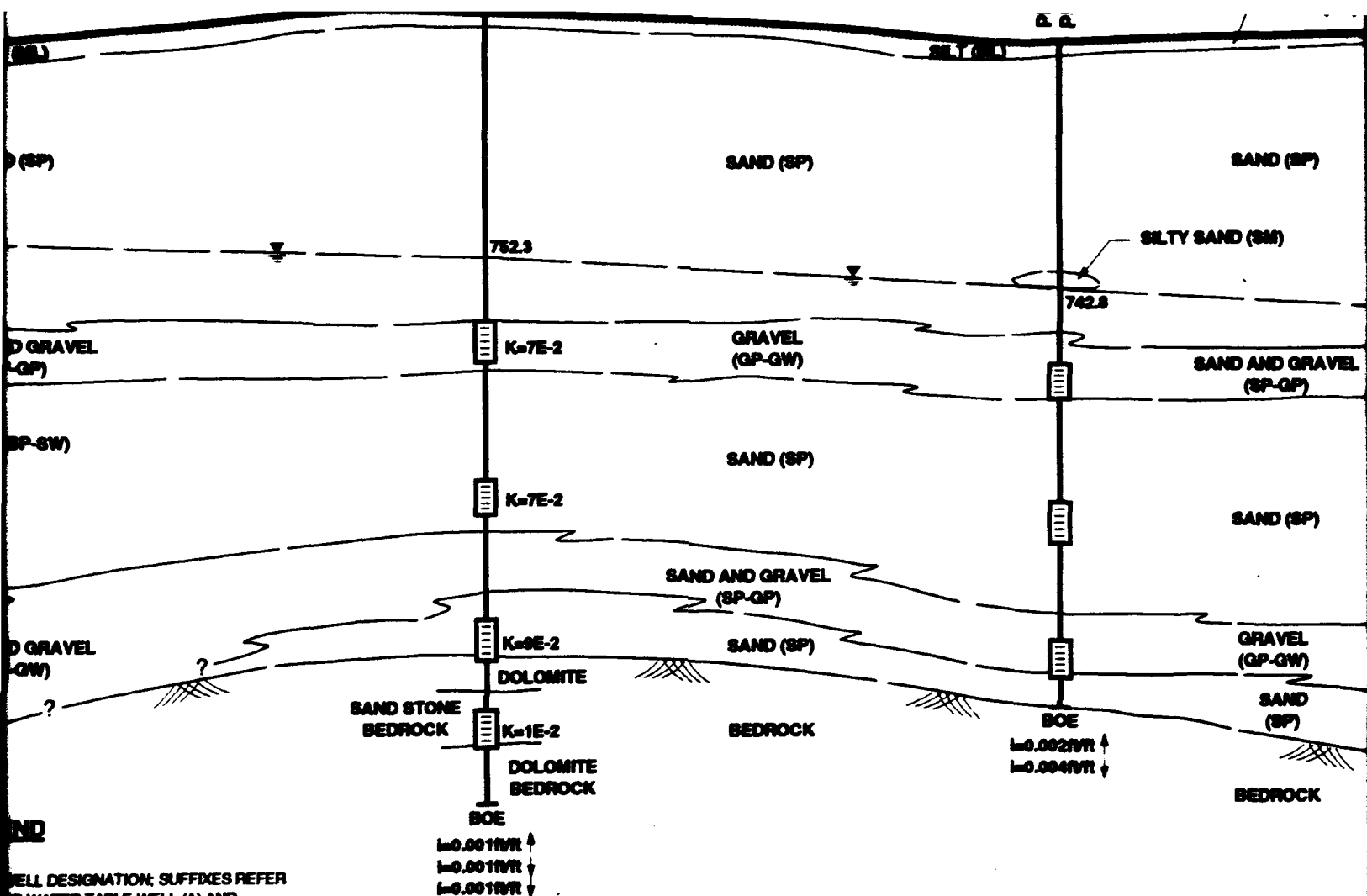


SCALE IN FEET



VERTICAL EXAGGERATION 1:20





WELL DESIGNATION; SUFFIXES REFER TO WATER TABLE WELL (A) AND PIEZOMETER (B&C)

GROUND SURFACE

SOILS DESCRIPTION AND USCS CLASSIFICATION

WATER TABLE ELEVATION

SCREENED INTERVAL

IN-FIELD PERMEABILITY TEST RESULT IN  $\text{cm/sec}$

BOTTOM OF EXPLORATION

GROUNDWATER VERTICAL GRADIENT

**FIGURE 1**  
**GEOLOGIC CROSS SECTION**  
**OFF-POST AREA SOUTH OF**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION**

ABB Environmental Services



Q'  
SOUTH

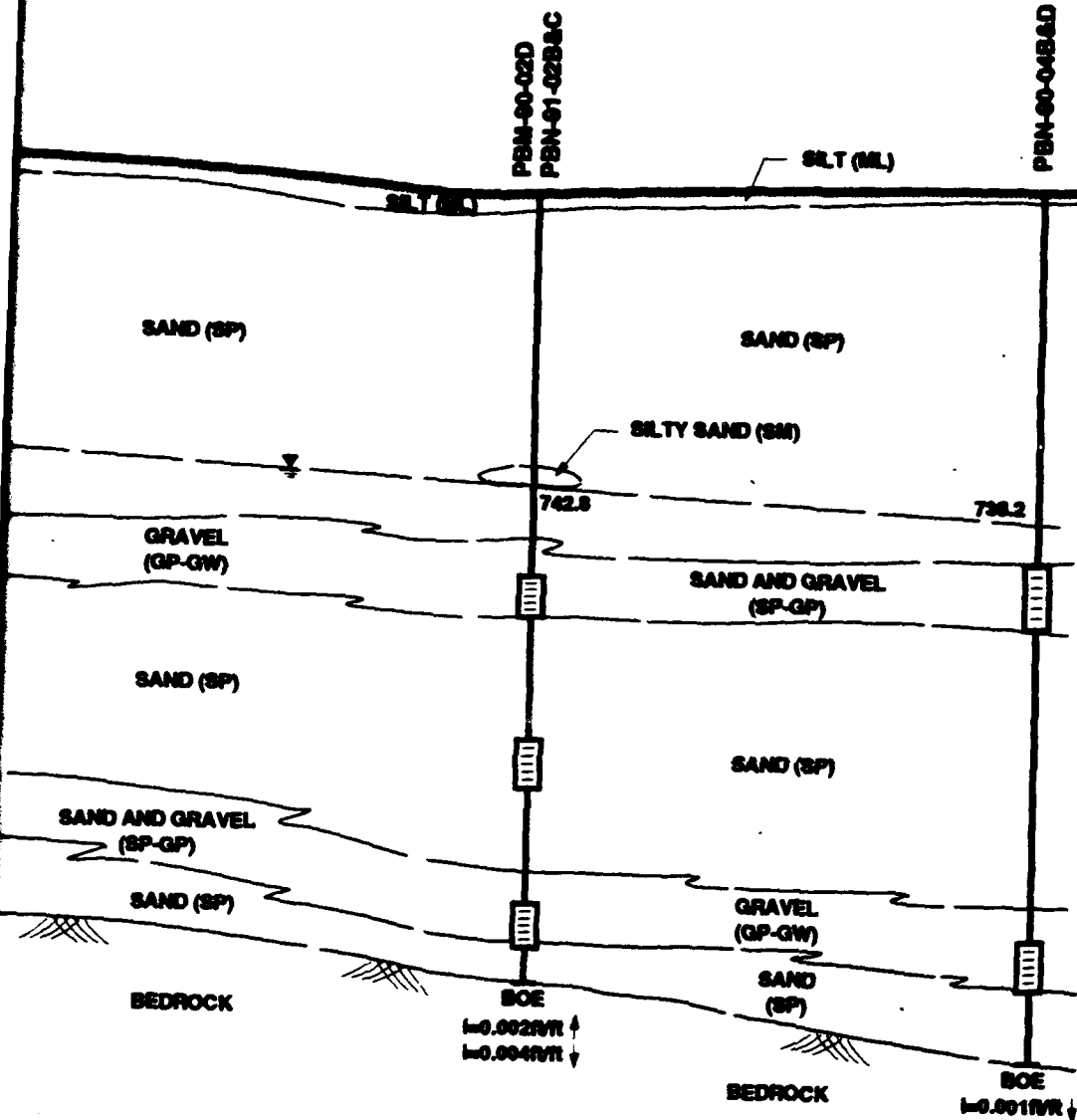
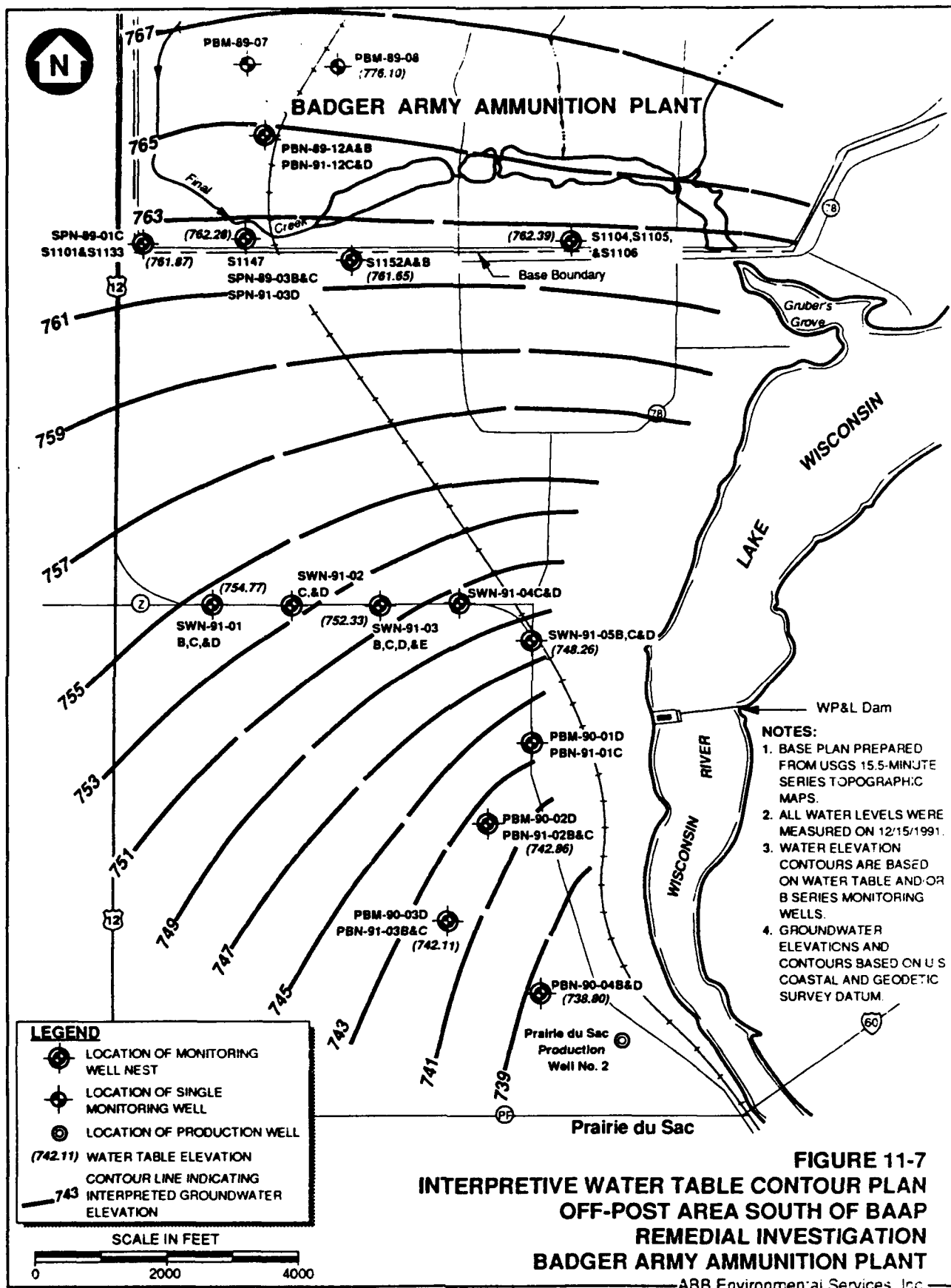


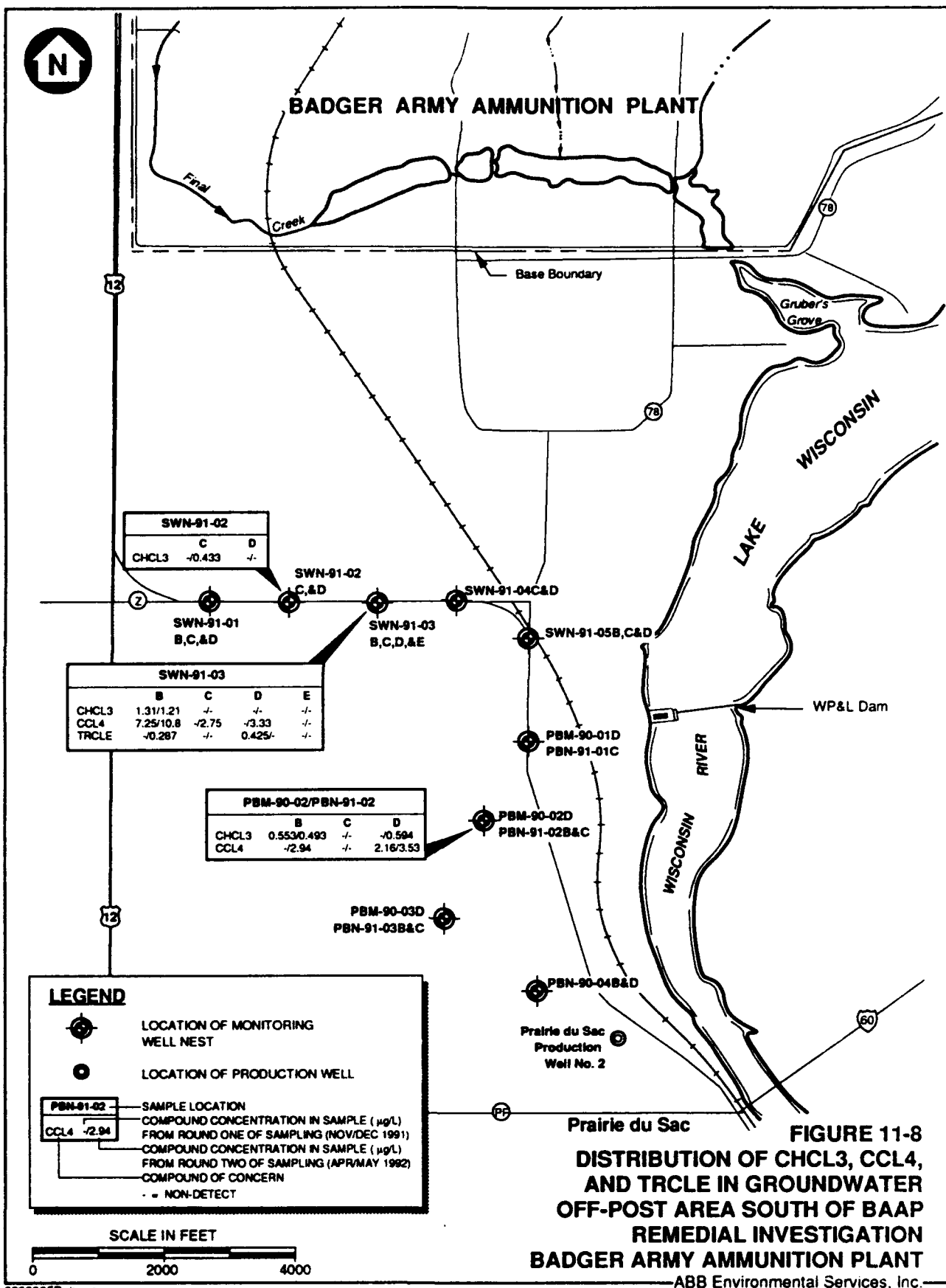
FIGURE 11-6  
GEOLOGIC CROSS SECTION Q-Q'  
OFF-POST AREA SOUTH OF BAAP  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT

ABB Environmental Services, Inc.

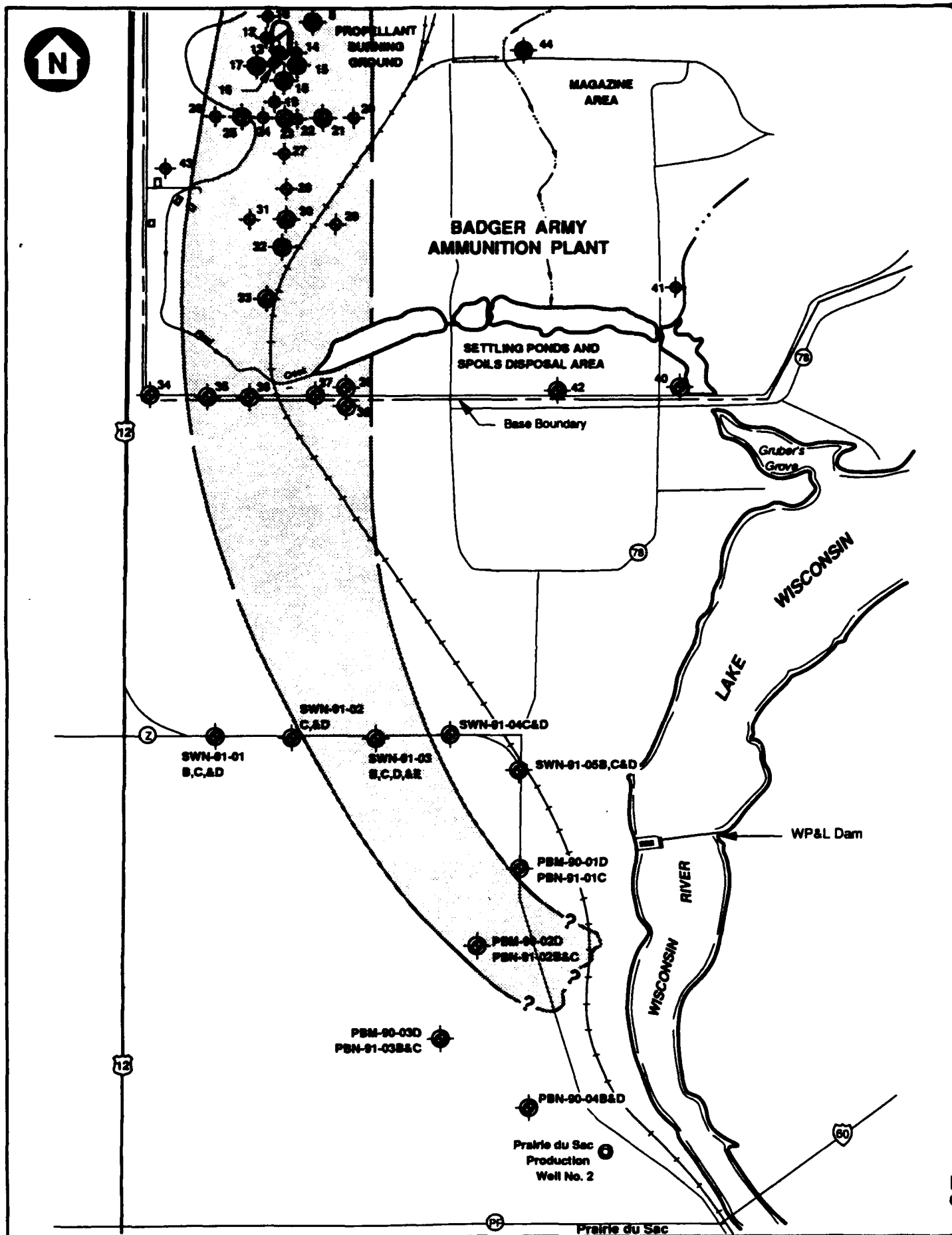
















MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
8	PBN-88-10A,B,C,&D	24	PBN-88-02	35	SPN-88-02A,B,&C
10	S1144	25	PBN-88-02B&C		SPN-81-02D
12	PBN-82-03		PBN-88-02A	36	SPN-88-02B&C
13	PBN-82-04	26	PBN-88-05		SPN-81-02D
14	PBN-82-05	27	PBN-88-04		S1147
15	PBN-82-05A,B,&C	28	PBN-88-06	37	SPN-88-04B&C
16	S1117	29	PBN-88-08		S1148, SPN-81-0
17	PBN-82-03A,B,&C	30	PBN-88-04B&C	38	S1102, S1103, S1
	S1146		PBN-88-04A	39	S1123A&B
18	PBN-82-04A,B,&C	31	PBN-88-07	40	SPN-88-05A&B
19	PBN-88-01	32	PBN-81-08C&D	41	S1110
20	PBN-88-08		PBN-88-08	42	S1104, S1105, S1
21	PBN-88-02B&C	33	PBN-88-12A&B	43	S1108
	PBN-88-02A		PBN-81-12C&D	44	S1115, S1116
22	PBN-88-03	34	SPN-88-01C		
23	PBN-88-01B,C,&D		S1101 & S1133		
	PBN-88-01A				

### LEGEND

- LOCATION OF MONITORING WELL NEST
- LOCATION OF SINGLE MONITORING WELL
- LOCATION OF PRODUCTION WELL
- INTERPRETIVE EXTENT OF VOC PLUME

### NOTE:

1. EXTENT OF VOC PLUME IS BASED ON DETECTION OF CHCL<sub>3</sub>, CCL<sub>4</sub> AND TRCE IN AT LEAST ONE ROUND OF SAMPLING.
2. SEE FIGURES 6-33 AND 6-34 FOR INTERPRETIVE PLAN VIEW OF PROPELLANT BURNING GROUNDFILL, LANDFILL 1, SETTLING PONDS AND SPOILS DISPOSAL AREA VOC PLUMES.
3. MONITORING WELL LOCATIONS BASED ON VERBICHER SURVEY DATA (APPENDIX F).

**INTERPRETIVE PLAN VIEW OF  
PROPELLANT BURNING  
SETTLING PONDS, SPOILS DISPOSAL  
AND OFF-POST AREA SOUTH  
REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

ABB Environmental









3

MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER	MAP CODE	WELL NUMBER
8	PBN-89-10A,B,C,&D	24	PBN-89-02	35	SPN-89-02A,B,&C
10	S1144	25	PBN-89-03B&C		SPN-91-02D
12	PBN-82-03		PBN-89-03A	36	SPN-89-03B&C
13	PBN-82-04	26	PBN-89-05		SPN-91-03D
14	PBN-82-05	27	PBN-89-04		S1147
15	PBN-82-05A,B,&C	28	PBN-89-05	37	SPN-89-04B&C
16	S1117	29	PBN-89-06		S1148, SPN-91-04D
17	PBN-82-03A,B,&C	30	PBN-89-04B&C	38	S1102, S1103, S1149
	S1146		PBN-89-04A	39	S1152A&B
18	PBN-82-04A,B,&C	31	PBN-89-07	40	SPN-89-05A&B
19	PBN-89-01	32	PBN-91-08C&D	41	S1110
20	PBN-89-06		PBN-89-06	42	S1104, S1105, S1106
21	PBN-89-02B&C	33	PBN-89-12A&B	43	S1109
	PBN-89-02A		PBN-91-12C&D	44	S1115, S1116
22	PBN-89-03	34	SPN-89-01C		
23	PBN-89-01B,C,&D		S1101 & S1133		
	PBN-89-01A				

### LEGEND

-  LOCATION OF MONITORING WELL NEST
-  LOCATION OF SINGLE MONITORING WELL
-  LOCATION OF PRODUCTION WELL
-  INTERPRETIVE EXTENT OF VOC PLUME

#### NOTE:

1. EXTENT OF VOC PLUME IS BASED ON DETECTION OF CHCL<sub>3</sub>, CCL<sub>4</sub> AND TRCLE IN AT LEAST ONE ROUND OF SAMPLING.
2. SEE FIGURES 8-33 AND 8-34 FOR INTERPRETIVE PLAN VIEW OF PROPELLANT BURNING GROUND, LANDFILL 1, SETTLING PONDS AND SPOILS DISPOSAL AREA VOC PLUMES.
3. MONITORING WELL LOCATIONS BASED ON VIERBICHER SURVEY DATA (APPENDIX F).

**FIGURE 11-9**  
**INTERPRETIVE PLAN VIEW OF VOC PLUME**  
**PROPELLANT BURNING GROUND,**  
**SETTLING PONDS, SPOILS DISPOSAL AREA**  
**AND OFF-POST AREA SOUTH OF BAAP**  
**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

ABB Environmental Services, Inc.



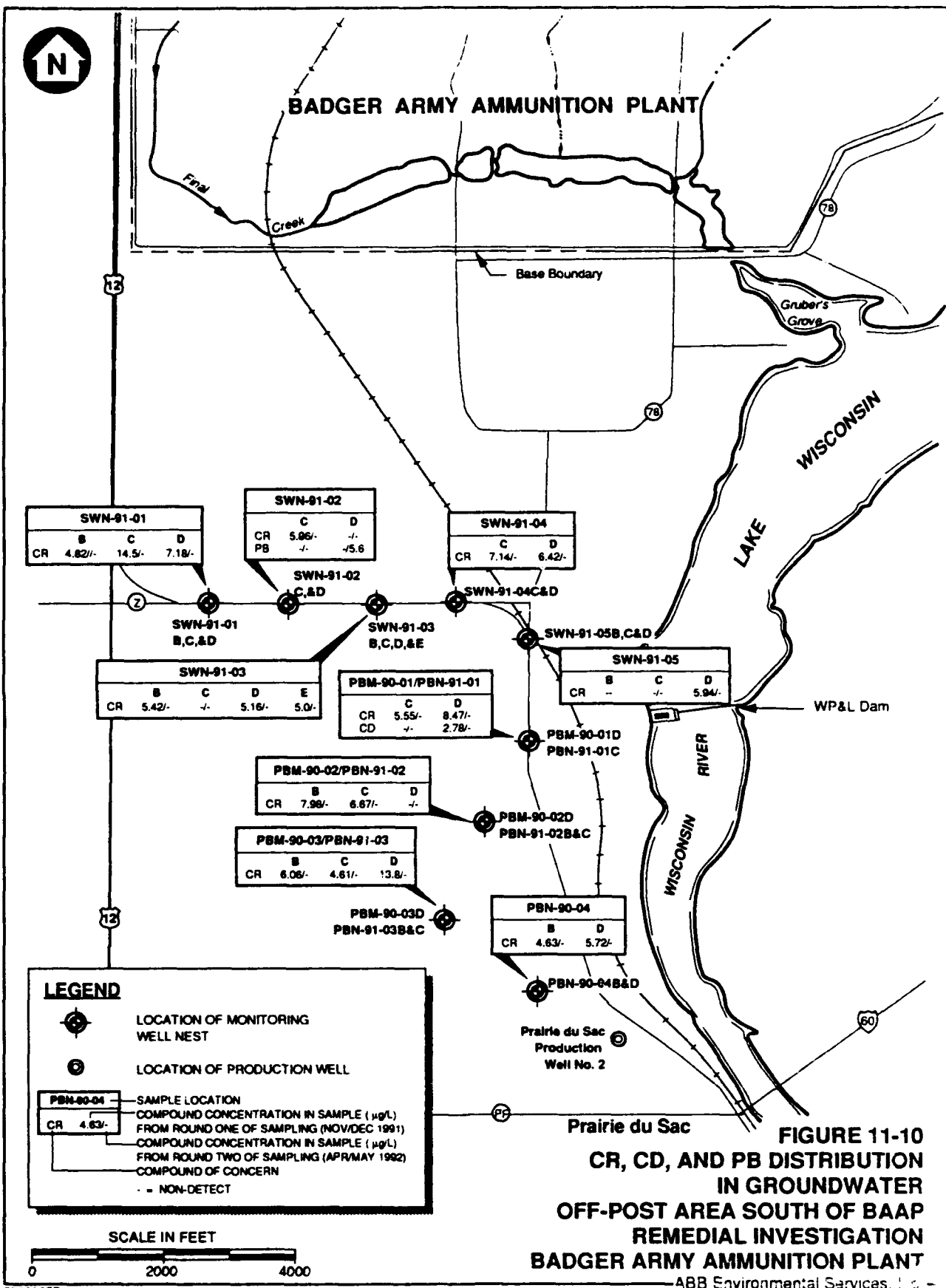




TABLE 12-1

**SUMMARY OF AREAS FOR WHICH  
REMEDIAL ACTION OBJECTIVES<sup>1</sup> ARE RECOMMENDED**

**REMEDIAL INVESTIGATION  
BADGER ARMY AMMUNITION PLANT**

AREA	MEDIUM (RECEPTOR)	COMPOUNDS
Propellant Burning Ground	Surface Soil (Human)	PB
	Surface Soil (Ecological)	PB <sup>2</sup> , CU <sup>2</sup> , HG <sup>2</sup> , SE <sup>2</sup> , ZN <sup>2</sup>
	Subsurface Soil (Human)	PB, 24DNT
Final Creek	Surface Soil (Ecological)	PB <sup>2</sup> , SN, 24DNT, SO <sub>4</sub> , DPA
Settling Pond 1	Surface Soil (Ecological)	PB <sup>2</sup> , SN, 24DNT, SO <sub>4</sub> , DEP
Settling Pond 2	Surface Soil (Ecological)	PB <sup>2</sup> , SN, DEP
Settling Pond 3	Surface Soil (Ecological)	PB <sup>2</sup> , SN
Settling Pond 4	Surface Soil (Ecological)	PB <sup>2</sup> , SN, AL <sup>2</sup>
Spoils Disposal Area 1	Surface soil (Ecological)	PB <sup>2</sup> , DPA, SN, NG, ZN <sup>2</sup>
Spoils Disposal Area 2	Surface Soil (Ecological)	PB <sup>2</sup> , SN, ZN <sup>2</sup>
Spoils Disposal Area 3	Surface Soil (Ecological)	PB <sup>2</sup> , SN, ZN <sup>2</sup>
Spoils Disposal Area 4	Surface Soil (Ecological)	PB <sup>2</sup> , SN <sup>2</sup> , ZN <sup>2</sup>
Spoils Disposal Area 5	Surface Soil (Ecological)	PB <sup>2</sup> , SN <sup>2</sup> , ZN <sup>2</sup>
Propellant Burning Ground/Settling Ponds	Groundwater (Human)	26DNT, CHCL <sub>3</sub> , BE, CCL <sub>4</sub> , TRCLE, NNDPA
Deterrent Burning Ground	Subsurface Soil (Human)	24DNT
Deterrent Burning Ground/Existing Landfill	Groundwater (Human)	26DNT, BE, 112TCE



continued

**TABLE 12-1**  
**SUMMARY OF AREAS FOR WHICH**  
**REMEDIAL ACTION OBJECTIVES<sup>1</sup> ARE RECOMMENDED**

**REMEDIAL INVESTIGATION**  
**BADGER ARMY AMMUNITION PLANT**

<b>AREA</b>	<b>MEDIUM (RECEPTOR)</b>	<b>COMPOUNDS</b>
Nitroglycerine Pond	Surface Soil (Human)	PB
	Surface Soil (Ecological)	PB <sup>2</sup> , HG <sup>2</sup> , NG
	Sediment (Ecological)	PB, HG
	Surface Water (Ecological)	AL, FE, HG, MN, PB
Rocket Paste Area	Surface Soil (Human)	PB, NG
	Surface Soil (Ecological)	24DNT, 26DNT, NNDPA, PB <sup>2</sup> , CR <sup>2</sup> , HG <sup>2</sup> , NG
	Sediment (Ecological)	PB
	Surface Water (Ecological)	AL, CR, CU, FE, MN, PB, ZN
Off-Post Wells South of BAAP	Groundwater (Human)	CCL4

**Notes:**

- <sup>1</sup> The aim of the Remedial Action Objective should be to reduce contact with or concentrations of the compounds listed for a specific media at a site.
- <sup>2</sup> Compounds whose risk-based PRGs are within naturally-occurring mean surface soil background concentrations.